

**Ryder Scott Company Reserves Conference**  
**May 6, 2005**

**SEC RESERVE BOOKING  
PRINCIPLES**

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# The Origin of This School


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# DISCLAIMER:

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- The information presented herein represents informed opinions about U.S. SEC reserves reporting regulations but does not purport to be identical to advice or rulings that may be obtained from the SEC.
- The SEC interprets each case individually & may alter interpretations based on facts particular to each case.

# Agenda

- 
- 1. Introduction**
  2. Types of Reserve Estimates
  3. SEC Proved Reserve Definitions
  4. SPE/WPC Probable Definitions
  5. SEC vs. SPE/WPC Reserve Definitions
  6. SEC Hot-Button Topics
  7. SEC Red Flag Items

# Introduction

## Why Are We Here?

- **Increased Surveillance by SEC since Enron**
- **Sarbanes-Oxley Act of 2002 (SOX) – Corporate Accountability**
- **SEC Comment Letters – October 2002 – sent to 55 producers**
- **SEC Audit Letters – November 2004 – sent to several producers**
- **Renewed emphasis on adherence to SEC definitions**
- **Many of the definitions are not clear – open to interpretation**
- **To ensure that reported reserves are fully compliant with SEC definitions & technically defensible**



# Introduction

## What Are the Outcomes?

- **Additional SEC comment letters & directives**
- **SOX adds significant penalties for non-compliance**
- **Increased audit volume and frequency**
- **14% of Attendees at SPEE Fall 2003 Conference asked to “de-book” or restate proved reserves by SEC**
- **During 2003 & 2004 several companies reduced previously reported proved reserves**



# Introduction – SEC Comment & Audit Letters

- A series of questions posed by accountants, lawyers, and engineers designed to test the compliance of the company with SEC regulations.
- The first answers are typically followed by a shorter list of questions, which may be more specific & ask for more detail.
- Iteration of letters may lead to request to restate previous filings, "de-booking" of reserves in subsequent reports or, simply, no more letters.

# Introduction – SEC Comment & Audit Letters

- Typical SEC question :
  - Please inform us of **any** circumstance where you have reported proved reserves located structurally **below the lowest-known hydrocarbons as established through well logs** and if these additional reserves have not been confirmed through performance history.



# Introduction – SEC Comment & Audit Letters

- Another common question asks:
  - Have you reported **any** undeveloped reserves attributable to well locations **more than one offset location** (“legal location”) away from a commercial well?

# Introduction – SEC Comment & Audit Letters

- Another common question asks:
  - Have you reported proved reserves in **untested** fault blocks, structures, or seismic amplitudes?

# Introduction – SEC Comment & Audit Letters

- A recent letter also posed the following:
  - Are **performance bonuses** linked to reserves increases?

# Introduction – SEC Comment & Audit Letters

- November 9<sup>th</sup>, 2004, the SEC sent a 9 page, 23 question inquiry to an independent US oil company
- Among other items, the SEC asked for:
  - A one line summary for each proved reserve entry on the books as of 12/31/2002 and 12/31/2003
  - Narratives, engineering and geological exhibits for the three largest reserve extensions or discoveries during 2003

# Introduction – SEC Comment & Audit Letters

- Hindsight analysis of 5 largest PUD locations booked as of 12/31/2002 drilled during 2003
  - Include the engineering and geological exhibits used to justify the reserve booking at each year end and a brief narrative reconciling the differences between the two estimates.
  - Address corporate methodology for eliminating future discrepancies between the estimates

# Introduction – SEC Comment & Audit Letters

- Narratives, engineering and geological exhibits for the 3 largest reserve revisions – both positive and negative – not caused by economics
- “Supplementally, tell us all the estimated hydrocarbon volumes, if any, you have claimed as proved reserves;
  - A) In undrilled fault blocks
  - B) Below the LKH – penetrated or assessed – structural occurrence of hydrocarbons”

# Introduction – SEC Comment & Audit Letters

- For the PUD locations as of 12/31/2002 drilled during 2003, provide a comparison table of projected capital expenditures and actual expenditures for each well. Explain any variances over 1%. (This is not a typo)
- Also prepare a list of the PUD wells as of 12/31/2002 projected to be drilled during 2003 and were not drilled. Provide an explanation as to why the wells were not drilled, if they are still carried as PUD locations as of 12/31/2003 and why they still qualify as PUD locations.

# Introduction – SEC Comment & Audit Letters

- Discuss the internal controls you have in place to assure consistency and conservatism in your proved reserve estimations.
- Discuss how the effectiveness of these controls is reflected in your history of proved reserve revisions over the past 3 years
- Identify the personnel in your company who have final authority over your proved reserves



# Introduction – Sarbanes-Oxley Act

- The Sarbanes-Oxley act of 2002 (SOX) is the most significant securities legislation since the Securities Acts of 1933 and 1934
- Does not contain the words, oil, gas, hydrocarbons or reserves
- Terms clearly there by inference
- Will lead to SEC reserves review of each public oil company **at least once every three years**
- Establishes penalties for corporate officers for certain misrepresentations

# Introduction – Sarbanes-Oxley Act

- Up to 10 years in federal prison for destroying, altering, concealing, or falsifying records.
- Up to 10 years in prison for failing to maintain all audit or review work papers for 5 years pertaining to an issuer of securities
- Up to 25 years in federal prison for knowingly defrauding shareholders.
- Possible fines of 25 MM\$ per offensive for corporations
- Fines for individuals possible
- Increased penalties up to 20 years in prison for violations under the SEC Act of 1934

# Introduction – Sarbanes-Oxley Act

## CEO/CFO Certification

- Management quarterly must state that they are responsible for establishing and maintaining internal controls
- Evaluate the effectiveness of their internal control system
- Acknowledge that they are responsible for designing and maintaining “disclosure controls and procedures”
- Confirm that the financial statements are correct

# Introduction – Sarbanes-Oxley Act

- This law was intended to bolster public confidence in our nation's capital markets.
- It imposes new duties and **significant penalties** for non compliance on public companies and their **executives, directors, auditors, attorneys, employees, and securities analysts.**
- Applies to SEC 10-K Companies
- Created Public Company Accounting Oversight Board.

# Introduction – Sarbanes-Oxley Act

## Warning from Jim Murphy (SEC engineer)

“If you are an independent engineer, you should realize that, although you are hired by management and report to them, the check you receive for your services comes from the Company, who are really the **Shareholders**. You have an **obligation** to the Shareholders to provide a fair, honest and unbiased reserves report.

If the SEC feels that reserves that have been booked as proved do not meet the requirements of being classified as proved reserves .... and they have a material effect on the company’s financial statement, **we will request that the company not only take the write-down if necessary, but also restate their reserves and financials for the past periods the reserves were on the books.**

This may have **serious consequences** under the new Sarbanes-Oxley Act of 2002 because the officers of the company will have had previously certified the financial statements as being correct.

Engineers appear to have additional liability under the act, as well; but this is yet to have been tested in court.”

# Introduction

## What are the outcomes ?

- **During 2003 & 2004 several companies took write offs totaling over 8 billion barrels and 50 TCF**
- **Companies had to restate year end reserves**
- **Restate quarterly reserves**
- **Restate earnings and company financials**



# Introduction

## What are the outcomes ?

- **Several companies replaced upper management, CEOs, CFOs, Presidents**
- **Other top management resigned**
- **Several companies replaced middle management**
- **Several Companies replaced a large part of their technical staff**



# Introduction

## What are the outcomes ?

- **Investigations by SEC, Department of Justice, US Postal Service, & other domestic & foreign government agencies have tied up company staffs for over a year.**
- **All records pertaining to reserve estimates are subject to subpoena – both internal & external**
- **Individuals may be charged with criminal wrongdoing**
- **Civil or criminal penalties may be assessed**





# Introduction

## What are the outcomes ?

- **Class action suits have been filed**
- **SEC & foreign government fines have reached as high as 151 MM\$**
- **Partners in common fields have also come under investigation**
- **Companies have sold fields to avoid a reserve write down**



# Introduction

## What are the outcomes ?

- **Stock prices dropped**
- **Additional public and industry scrutiny**
- **Increased Doubt by investment analysts**
- **Potential downgrading by bond rating agencies**



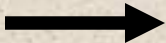
# Introduction

## What are the outcomes ?

- **Millions spent by companies on SOX compliance, reserve reporting, & corrections to previous reports.**
- **Congressmen Dingle's letter to SEC**
- **SEC reaction to Congressional pressure**



# Agenda

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1. Introduction
  - 2. Types of Reserve Estimates**
  3. SEC Proved Reserve Definitions
  4. SPE/WPC Probable Definitions
  5. SEC vs. SPE/WPC Reserve Definitions
  6. SEC Hot-Button Topics
  7. SEC Red Flag Items

# Elements of Reserve Estimates

## Uncertainty vs. Risk

- Uncertainty
  - The percentage by which an estimated quantity may vary from the actual quantity
- Risk
  - The probability of success or failure

# Types of Reserve Estimates

In 1997 the SPE & WPC Recognized two acceptable methods for estimating Reserves

- **Deterministic**
- **Probabilistic**



# Types of Reserve Estimates

## Deterministic Estimates

A single best estimate of reserves is made based on known geological, engineering and economic data.

The deterministic approach may incorporate elements of probabilistic analysis within the SEC definitions. For example, a distribution of porosity,  $S_w$ , RF, or other factors may be appropriate.

Distributions which include a variable outside of the SEC definitions may not be used.



# Types of Reserve Estimates

## Probabilistic Estimates

- **Geological, engineering and economic data are used to generate a range of estimates and their associated probabilities.**
- **In situations involving a significant degree of uncertainty, probabilistic estimates are often more appropriate than a deterministic estimate.**
- **Probabilistic estimates are preferred by many oil & gas companies and accepted for reserve work by several foreign governments. The SEC does not accept a probabilistic reserve determination if any parameter does not meet the SEC criteria.**





# Types of Reserve Estimates

## Concerns with Probabilistic Estimates

- **Several companies have historically booked the probabilistic P<sub>50</sub> number as proved reserves and have been asked to write down those numbers and replace them with a deterministic estimate which conform to SEC standards.**



# Types of Reserve Estimates

- How is uncertainty quantified for these methods?
  - Deterministic – Based on “Reasonable Certainty”
  - Probabilistic – Requires 90% Certainty (SPE/WPC)

Both may need to be adapted to meet regulatory standards



# Reserve Categories

## DETERMINISTIC APPROACH

<u>Category</u>	<u>Descriptive Term</u>	<u>Definition</u>
Proved	Reasonable certainty	SEC - 1978
Probable	More likely than not	SPE/WPC - 1997
Possible	Less likely than probable	SPE/WPC - 1997
Prospective	Undiscovered resources	SPE/WPC/AAPG 2000



# Reserve Categories

## PROBABILISTIC APPROACH

### Category

### Descriptive Term

**Proved (1P)**

**At least 90 % probability**

**Proved + Probable (2P)**

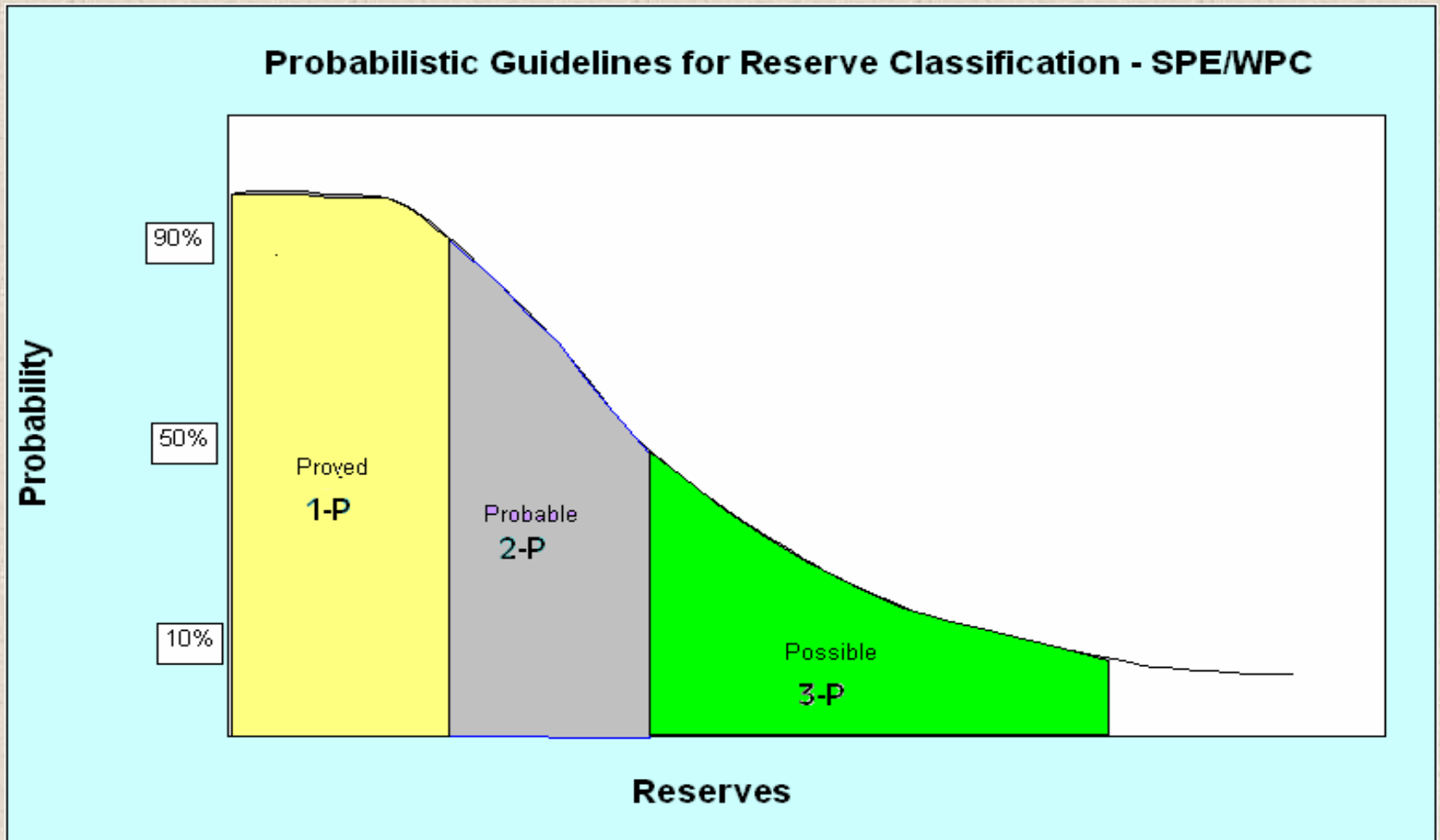
**At least 50 % probability**

**Proved + Probable + Possible (3P)**

**At least 10 % probability**



# Reserve Categories



# Reserve Categories

**Is the SEC giving consideration to probabilistic reserves definitions? (SPEE-SEC 2002)**

*ANSWER: Winfrey – **No!***

**“We accept those estimates as long as they adhere to our definitions like LKH. There are obviously probabilistic estimates which would attribute reserves below LKH- they would say there is a finite probability of it, but we would not accept that.”**

**The SEC will accept probabilistic estimates only if prepared by a “professional”**



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1. Introduction
2. Types of Reserve Estimates
- 3. **SEC Proved Reserve Definitions**
4. SPE/WPC Probable Definitions
5. SEC vs. SPE/WPC Reserve Definitions
6. SEC Hot-Button Topics
7. SEC Red Flag Items

# SEC Mission and Objectives

- SEC administers federal securities laws and issue rules and regulations to provide **protection for investors** and ensure the securities **markets are fair and honest**.
- SEC promotes the **full and effective disclosure** to the investing public.
- SEC does not conduct merit review – does not guarantee the value or merit of an investment.
- SEC cannot prohibit the sale of securities of questionable value. The investor must make the ultimate judgment of the worth of any securities offered for sale.



# SEC Reserve Definitions

- SEC regulations applicable to oil and gas:
  - Regulation S-X, 210.4-10
    - Defines oil and gas producing activities
    - Defines proved oil and gas reserves
  - Guidelines to Regulation S-X, 210.4-10
    - Accounting Series Release No. 257 – Topic 12
    - March 2001 – Interpretations and Guidance
- Other regulations
  - Federal Accounting Standard Board (FASB)
    - FASB #69 reserves reporting guidelines

# SEC Reserve Definitions



- **What Skills Do I Need to Learn this Stuff?**
- Black frame glasses
- Snappy dresser
- Pocket Calculator
- Pentel Pencil in Pocket
- Card Key on Belt
- Charismatic
- ***Ready for Action***

# SEC Reserve Definitions

- Proved reserves only
- Approved in 1978
- Applications Modified in part by
  - Staff Accounting Bulletins
  - Web site releases
  - Letters to operators
  - SEC-SPEE Forums

# SEC Reserve Definitions

The SEC guidelines state “the intent of the definition of proved reserves is interpreted as estimates that are more likely to result in a **positive revision** than a **negative revision**” (a deliberate low estimate, which is a probabilistic bias).

Best use of all available engineering, geological, and geophysical data, good engineering judgment, and use of analogous reservoirs should be used to estimate the recovery efficiencies and other engineering parameters involved in the estimation of reserves for investment purposes to establish a compelling case that influences the SEC acceptance for booking of proved reserves.

**The ultimate test of reasonable certainty is reservoir performance.**



# SEC Reserve Definitions

- Does this mean we will always have to “low-ball” our proved SEC estimates?
- No, It means we need to do the **best possible technical analysis, document our estimates**, and conform to the SEC regulations while presenting a compelling case to defend our estimates.
- The documentation must be **kept** for audit purposes



# SEC Reserve Definitions

## **SEC 1978 –Current Definition** *(Rule 4.10 Regulation S-X)*

**Proved oil and gas reserves are:**

- **the estimated quantities of crude oil, natural gas, and natural gas liquids, which**
- **geological and engineering data demonstrate with reasonable certainty**
- **to be recoverable in future years**
- **from known reservoirs**
- **under existing economic and operating conditions;**
- **i.e., prices and costs as of the date the estimate is made.**

# SEC Reserve Definitions

## SEC 1978 –Current Definition -continued

- (i) Reservoirs are considered proved if economic producibility is supported by either:
  - Actual Production
  - Conclusive Formation Test.
    - What constitutes a “Conclusive Formation Test”?



# SEC Reserve Definitions

**April 15, 2004** – In the deepwater GOM, the SEC will not object to booking proved reserves without a production flow test, if the following 4 criteria are met :

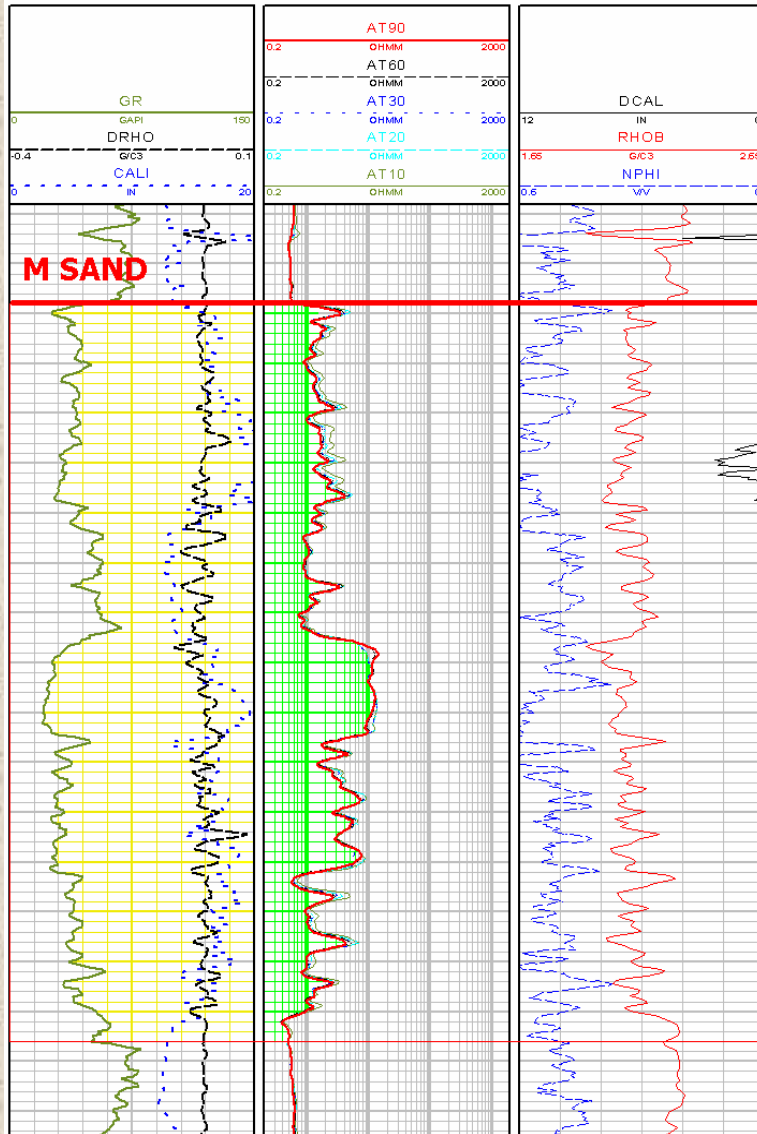
- WELL LOGS,
- SIDEWALL CORES or CONVENTIONAL CORE,
- MDT TESTING for pressure, fluid sample, and permeability, &
- SEISMIC INTERPRETATION

For all 4, methods are technically definitive, mutually supportable, & show commercial producibility.



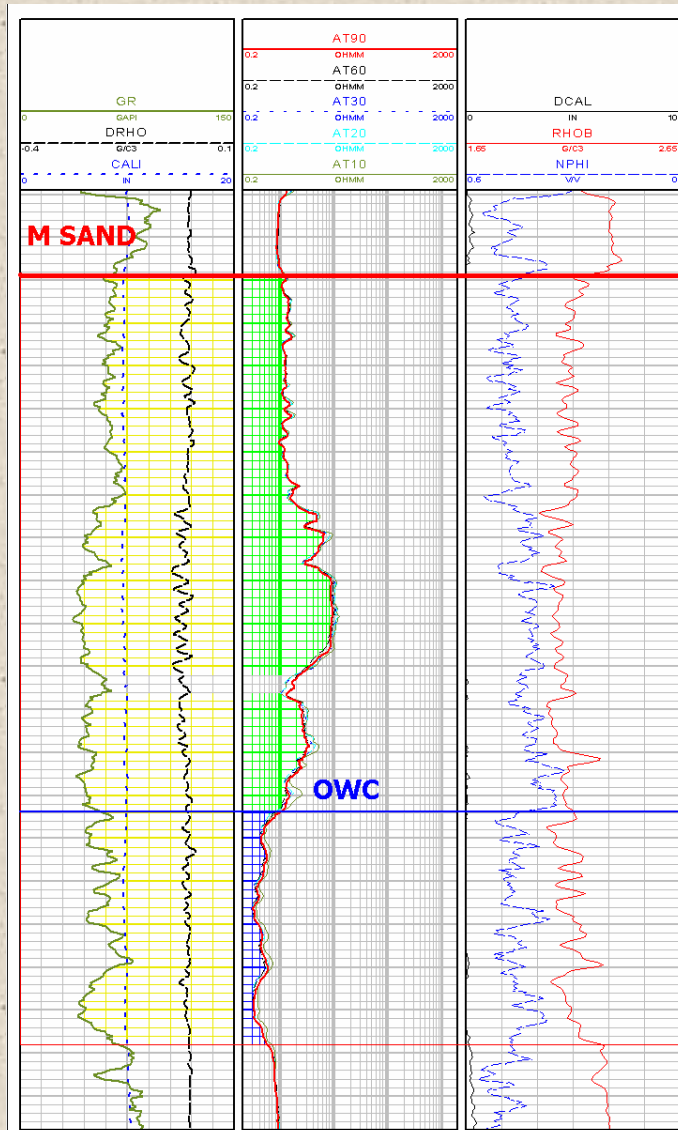


# 1 - CONVENTIONAL LOG ANALYSIS



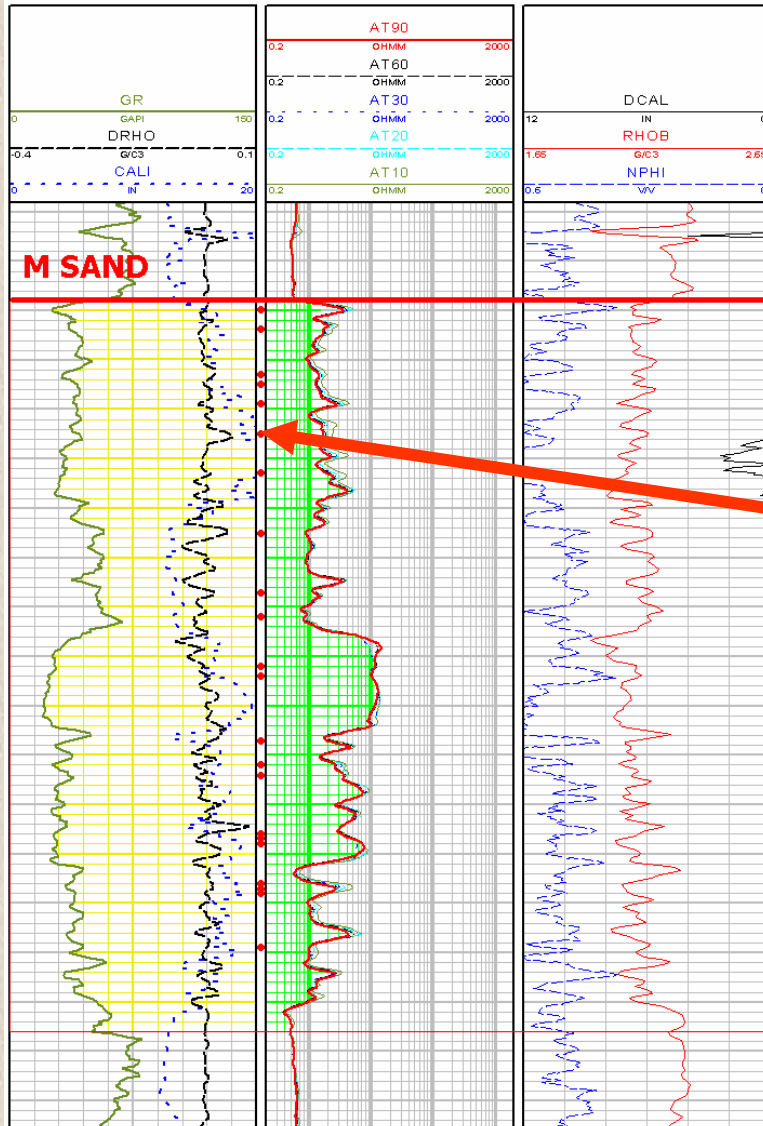
- WELL #1
- INTERPRETED LOG
- 108' OF PAY
- 30.1 % POROSITY
- 29.6 % Sw

# 1 - CONVENTIONAL LOG ANALYSIS



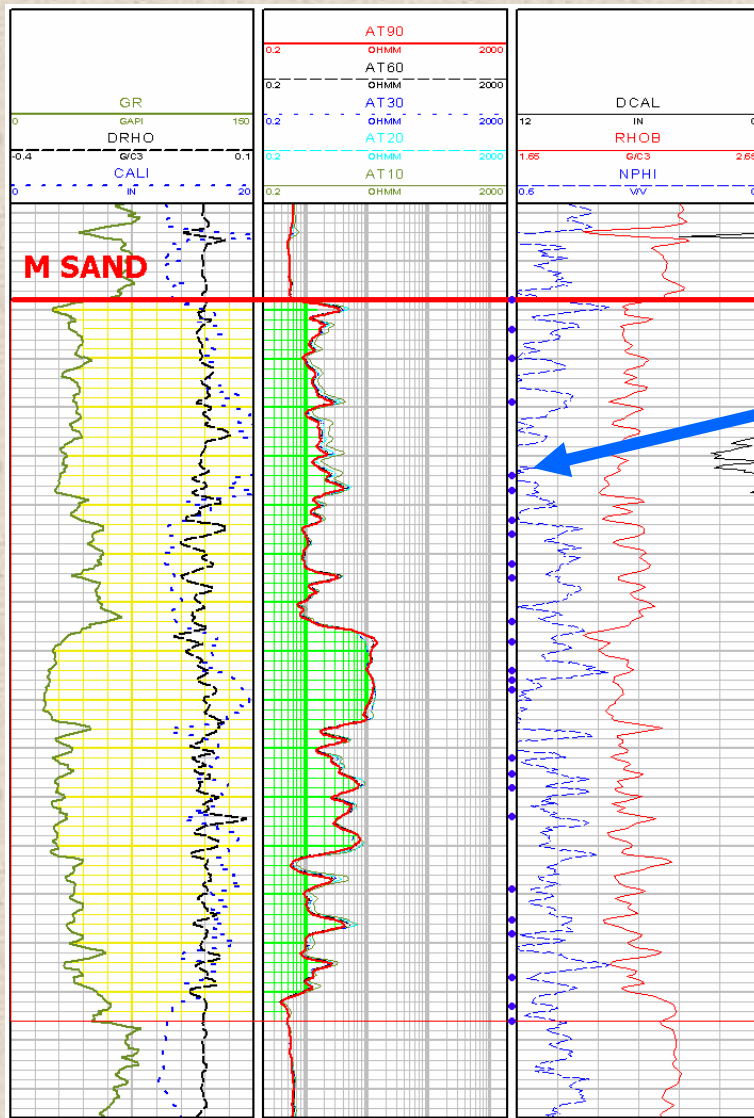
- WELL #2
- INTERPRETED LOG
- 116' OF PAY
- 29.8% POROSITY
- 35.9% Sw

# 2 - CORE ANALYSIS



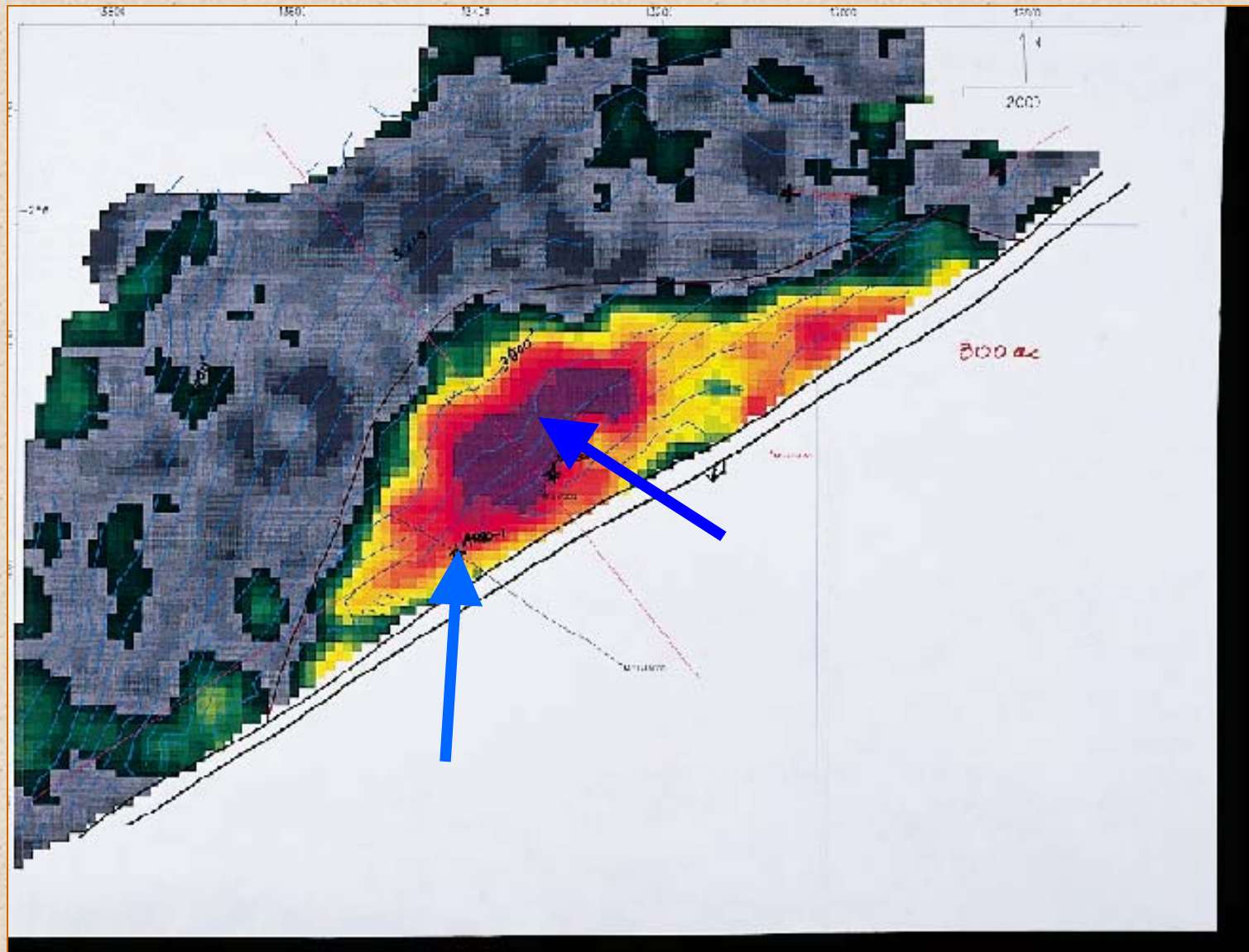
- WELL #1
- 25 SIDEWALL CORES

# 3 – MDT ANALYSIS



- WELL # 1
- 24 MDT's
- 2 FLUID SAMPLES

# 4 – Seismic Confirmation



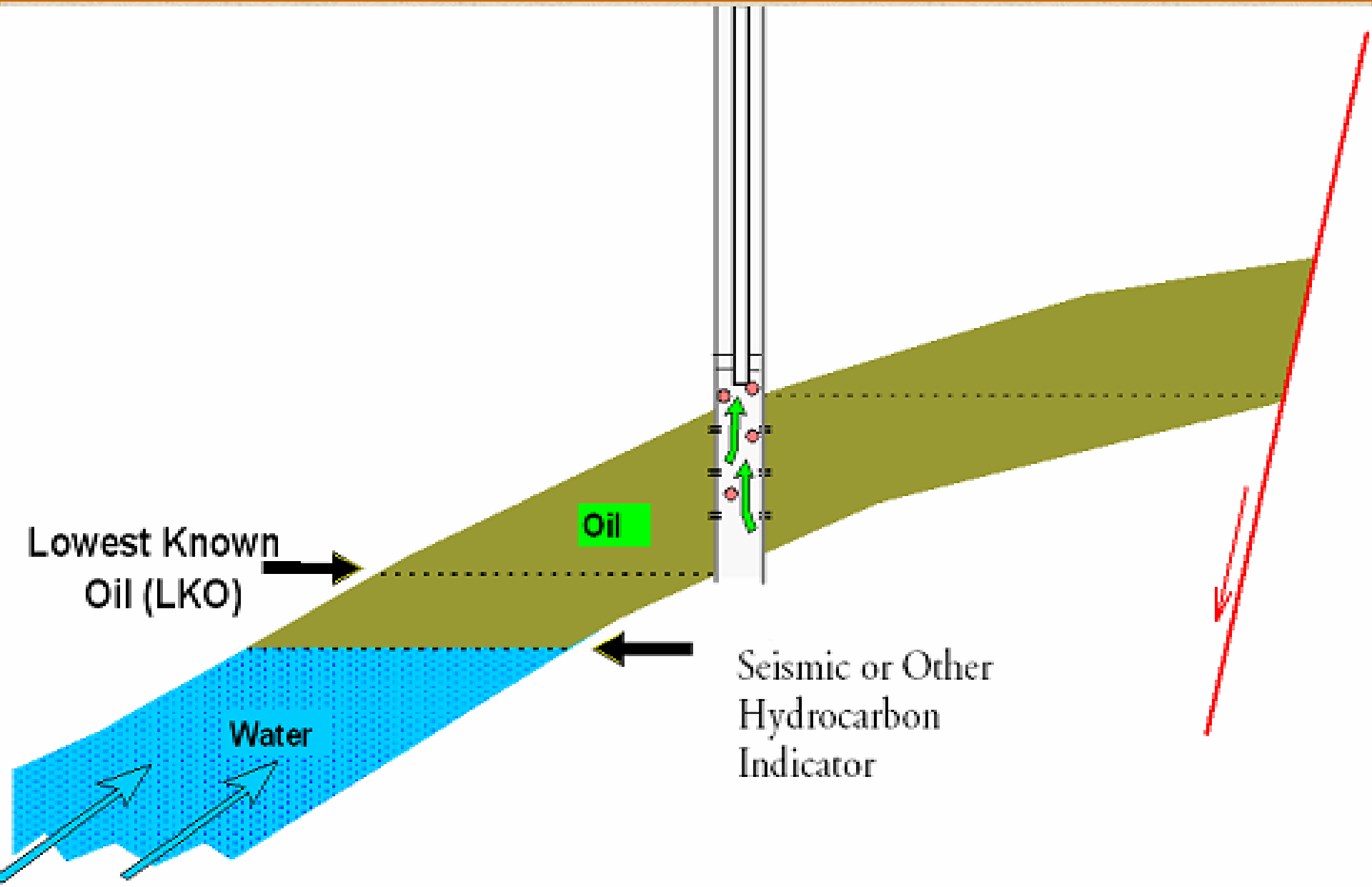
# SEC Reserve Definitions

## SEC 1978 –Current Definition -continued

- The area of a reservoir considered proved includes
  - that portion delineated by drilling and defined by gas-oil and/or oil-water contacts, if any and
  - the immediately adjoining portions not yet drilled, but which can be reasonably judged as economically productive on the basis of available geological and engineering data.
- In the absence of information on fluid contacts,
  - the lowest known structural occurrence of hydrocarbons controls the lower proved limit of the reservoir



# SEC Reserve Definitions



# SEC Reserve Definitions

## SEC 1978 –Current Definition -continued

(ii)

- Reservoirs which can be produced economically through application of improved recovery techniques (such as fluid injection) are included in the “proved” classification when:
  - successful testing by a pilot project, or
  - the operation of an installed program in the reservoir provides support for engineering analysis on which the project or program was based.





# SEC Reserve Definitions

## SEC 1978 –Current Definition -continued

(iii)

- Estimates of proved reserves do not include the following:
  - Crude oil, natural gas, and natural gas liquids, the recovery of which is subject to **reasonable doubt** because of **uncertainty as to geology, reservoir characteristics or economic factors**
  - Crude oil, natural gas, and natural gas liquids, that may occur in **un-drilled prospects**
  - Crude oil, natural gas, and natural gas liquids, that may be recovered from oil shale, coal, gilsonite and other such sources.-  
**Unconventional sources.**
  - **By-products** such as Sulfur, Helium, or CO2
    - Technically must adjust volumes for non-hydrocarbons, but SEC considers 3-5% immaterial, if pipeline will accept



# SEC Reserve Definitions

## Proved Reserve Status

### Developed

- Producing - PDP
- Behind Pipe – BP or PDNP
- Shut In – SI or PDNP

### Undeveloped - PUD

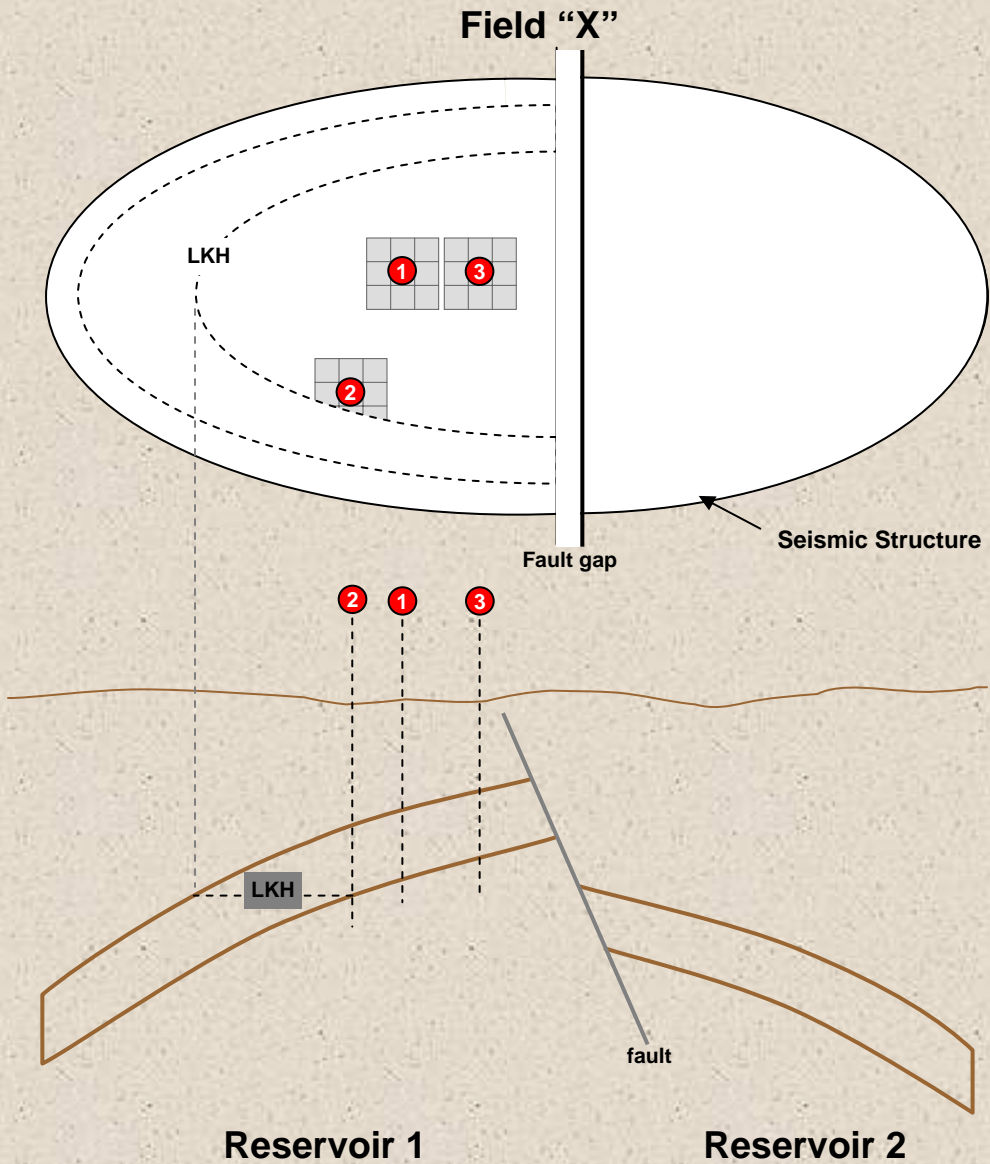
# SEC Reserve Definitions



## SEC 1978 –Current Definition -continued

- Proved Developed Reserves:
  - Those reserves that can be **expected to be recovered** through **existing wells** with **existing equipment** and operating methods.
  - Additional oil and gas expected to be obtained through the application of fluid injection or other improved recovery techniques for supplementing the natural forces and mechanisms of primary recovery should be included as “Proved Developed Reserves” only after **testing by a pilot project** or after the operation of an installed program has **confirmed** through **production response** that increased recovery will be achieved.
  - Expansion of an improved recovery operation is still **undeveloped**



# SEC Reserve Definitions - Proved



	Well
	Proved, Assigned Acreage

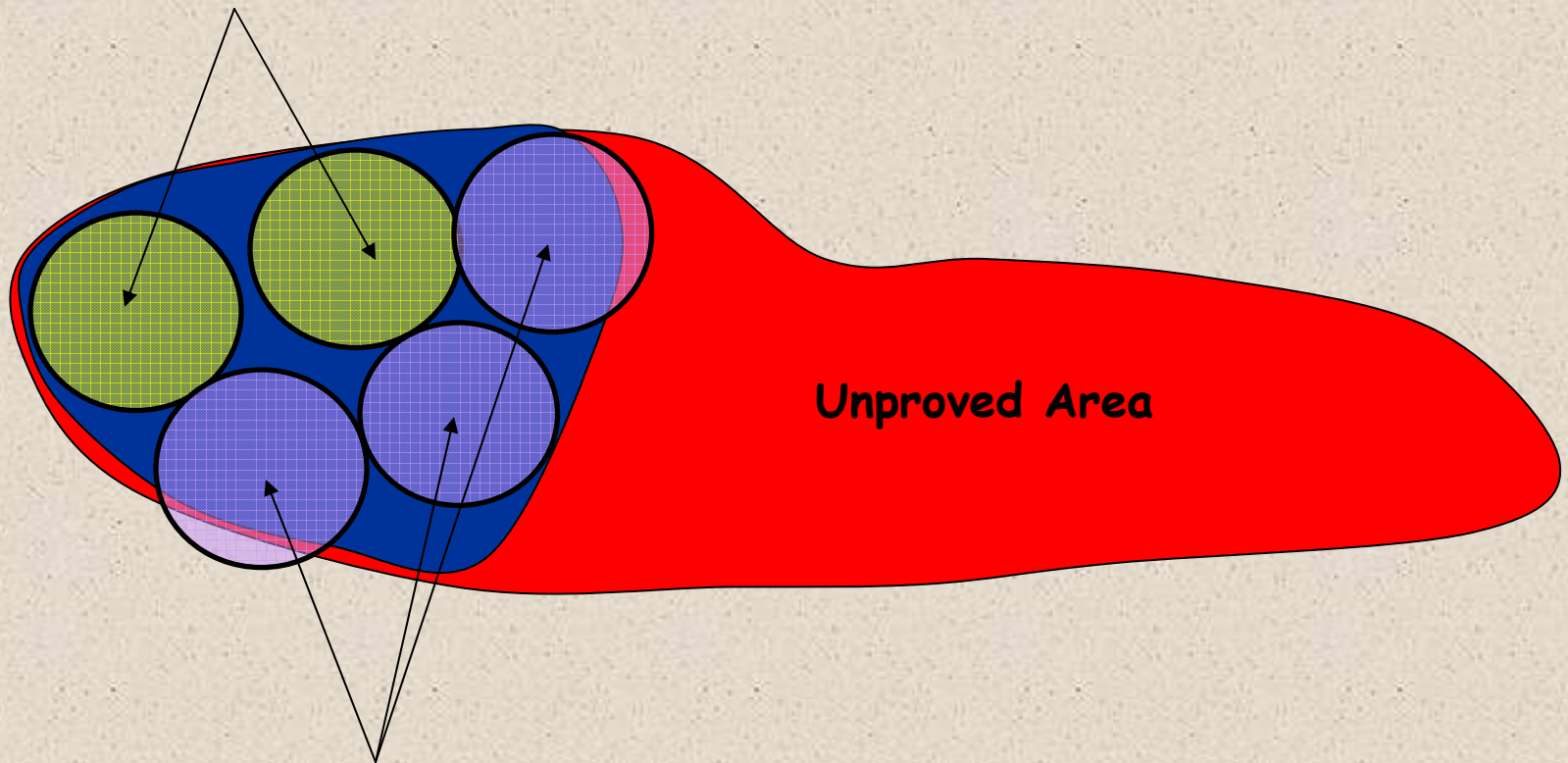
# SEC Reserve Definitions

## SEC 1978 –Current Definition -continued

- Proved Undeveloped Reserves (PUD's):
  - Those reserves that are expected to be recovered from **new wells** on **un-drilled acreage**, or from **existing wells** where a relatively **major expenditure** is required for recompletion. (This may include compression)
  - Reserves on undrilled acreage shall be **limited** to those drilling units **offsetting** productive units that are **reasonably certain** of production when drilled.
  - Proved reserves for other undrilled units can be claimed **only** where it can be demonstrated with **certainty**, that there is **continuity** of production from the existing productive formation.
  - Under no circumstances should estimates for proved undeveloped reserves be attributable to any acreage for which an application of fluid injection or other improved recovery technique is contemplated, unless such techniques have been proved effective by actual tests in the area and in the same reservoir.

# SEC Reserve Definitions

**2 Exploration Wells (continuity & communication confirmed)**



**Proved Undeveloped  
Locations**

**Unproved Area**

# SEC Reserve Definitions

- Improved recovery
  - Reserves cannot be classified as proved undeveloped reserves based on improved recovery techniques **until**
  - such time that they have been proved effective in **that reservoir** or an **analogous reservoir** in the **same geologic formation** in the **immediate area**.
  - An analogous reservoir is one having **at least** the **same** values or **better** for porosity, permeability, permeability distribution, thickness, continuity, fluid properties, and hydrocarbon saturations.

# SEC Reserve Definitions

- Natural gas in storage is not considered reserves
  - Gas once removed from its native reservoir and injected into another for any purpose can not be considered reserves
  - gas re-injected into its native reservoir can be considered reserves until produced and sold.



# PUD Summary

- Direct offset to production above LKH
- May require significant capital well work
- Requires New or Modifications to Facilities
  - Changes to facility or facility design
  - Compression / Treatment / Gathering
  - Transmission to market
- Improved Recovery based on pilot or analogy
  - SEC engineers expect revisions to be positive most of the time
- Operator should have “track record”, plus
  - **commitment to do the work**
  - **financial resources to do the work**

# Agenda

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2. Types of Reserve Estimates
3. SEC Proved Reserve Definitions
- 4. **SPE/WPC Probable Definitions**
5. SEC vs. SPE/WPC Reserve Definitions
6. SEC Hot-Button Topics
7. SEC Red Flag Items

# SPE/WPC Reserve Definitions

- **SEC**
  - Securities & Exchange Commission (SEC)
- **SPE/WPC**
  - Society of Petroleum Engineers (SPE)
  - World Petroleum Congress (WPC)

Proved Reserves	Probable Reserves	Possible Reserves
SEC SPE/WPC	- SPE/WPC	- SPE/WPC
1P →		
→ 2P →		
→ 3P →		

# SPE/WPC Reserve Definitions

## Probable Reserves

- Probable reserves are reserve estimates in known reservoirs which cannot yet be considered reasonably proved on the basis of **current** geologic and engineering information.

**This is an industry definition. Not recognized by SEC**

### Comment

These volumes are expected to become proved as additional information becomes available, and it is important to be able to define the event which will allow the reserves to become proved.



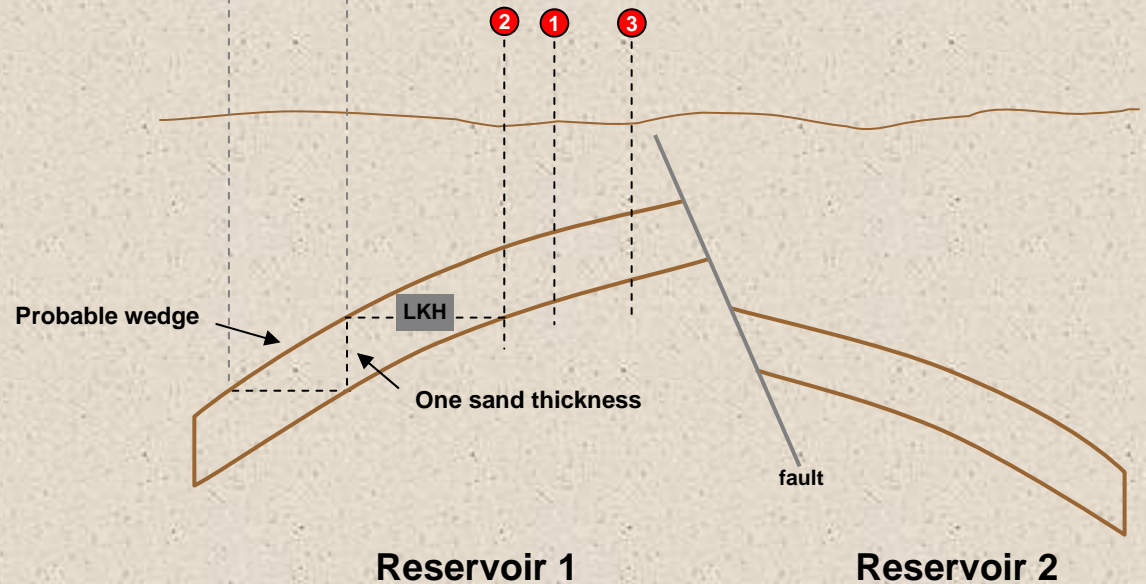
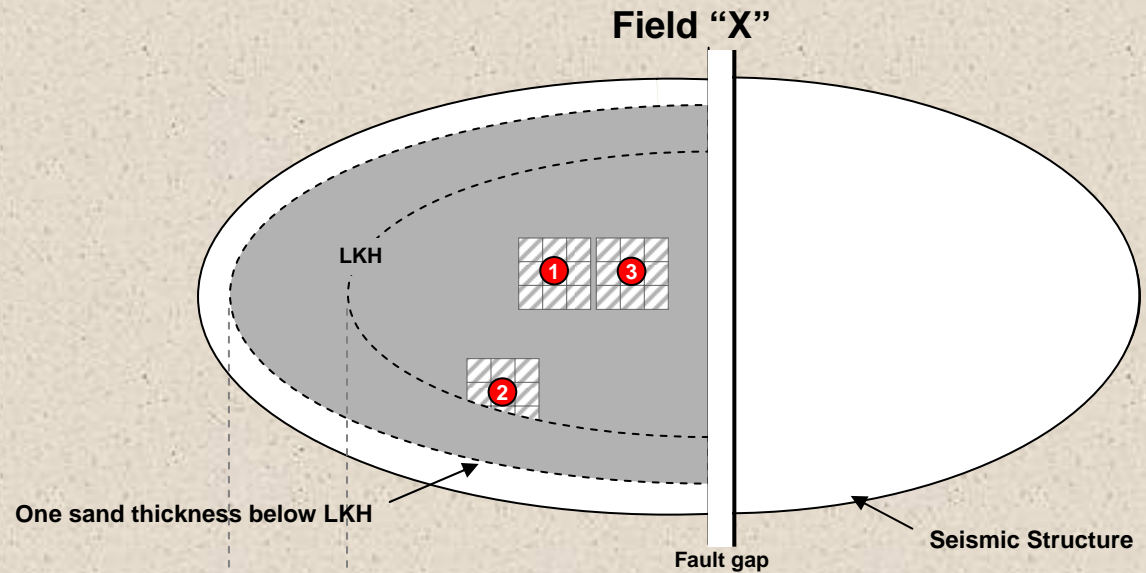
# SPE/WPC Reserve Definitions - Probable

- Typical Examples
  - Volumes below “lowest known” hydrocarbons
  - Recovery factor greater than proved volumes
  - Untested zones
  - Questionable log analysis – low  $R_t$ , high  $S_w$ , low porosity
  - Fault blocks without penetrations
  - Down-spacing without regulatory approval

# SPE/WPC Reserve Definitions - Probable

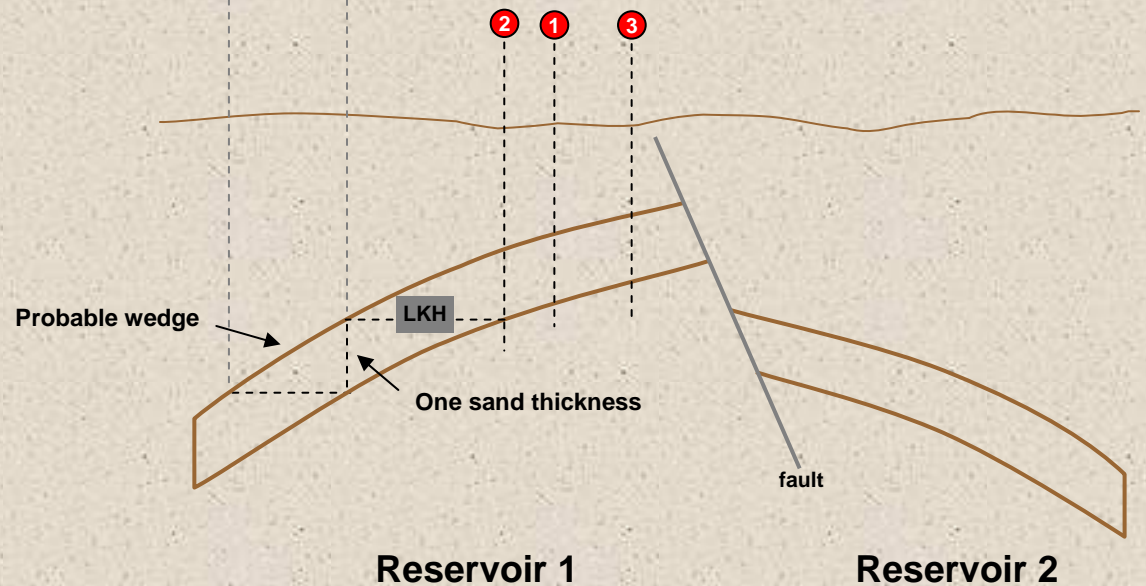
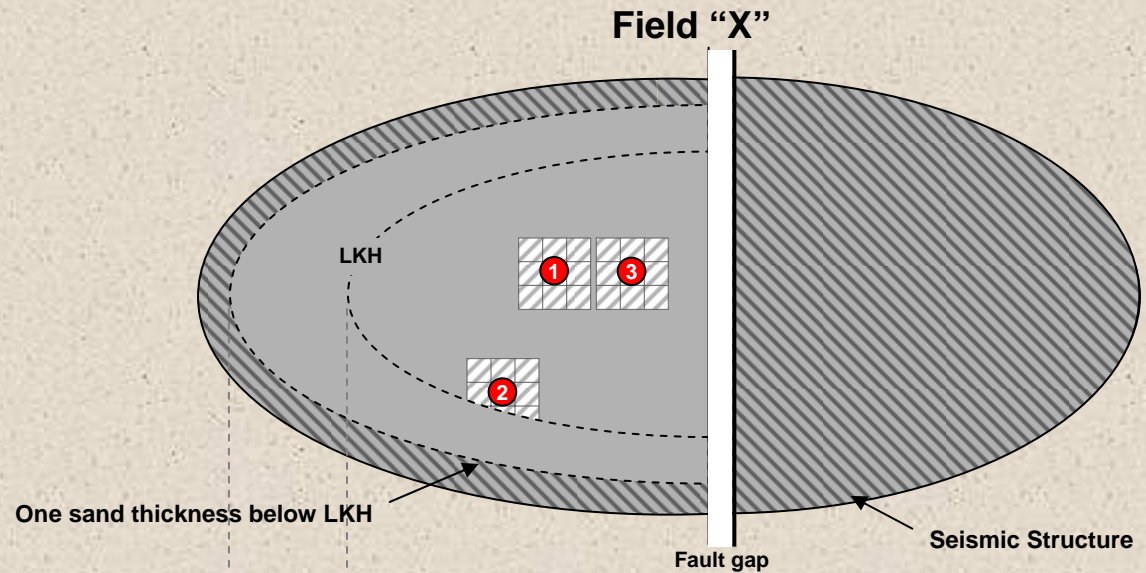
- Typical Examples
  - Down-spacing with questionable drainage patterns
  - Market, contract limitations
  - Enhanced recovery without successful testing
  - Certain step-out development wells
  - Work-over treatments without analogies
  - Alternative performance interpretation







# SPE/WPC Probable Example



- Well
- Proved, Assigned Acreage
- Proved Developed
- Proved Undeveloped
- Probable

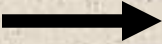
# SPE/WPC Possible Example



-  Well
-  Proved, Assigned Acreage
-  Proved Developed
-  Proved Undeveloped
-  Probable
-  Possible



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# SEC vs. SPE/WPC Reserve Definitions

In 1997 SPE and the WPC proposed their definitions as the worldwide, technical standard for reserves and classifications.

Countries and organizations including the SEC were encouraged to adopt as much as possible from this standard for regulatory and other purposes.

***“Do not expect SEC to merge or accept SPE definitions”***

SEC – Jim Murphy October 2003, SPEE Houston

# SEC vs. SPE/WPC – economic conditions

## SEC 1978

- under **existing economic and operating conditions**, i.e., **prices and cost as of the date the estimate is made**.
- Prices include consideration of changes in existing prices provided only by contractual arrangements, but not on escalation based upon future conditions. Hedges are **NOT** allowed unless they are field or lease specific.

## SPE/WPC 1997

- Establishment of current economic conditions should include relevant **historical petroleum prices and associated costs and may involve an averaging period** that is consistent with the purpose of the reserve estimate.



# SEC vs. SPE/WPC – economic conditions

1. Existing economic and operating conditions include current
  - product prices,
  - operating costs,
  - production methods,
  - recovery techniques,
  - transportation and marketing arrangements,
  - royalty relief
  - production tax relief
  - ownership and/or entitlement terms and
  - regulatory requirements
2. An anticipated change must be **reasonably certain to occur.**
3. Includes duration of current licenses and permits.

# SEC vs. SPE/WPC – “reasonable certainty”

## SEC 1978

- Not defined

## SPE/WPC 1997

- If deterministic methods are used, the term reasonable certainty is intended to express a **high degree of confidence** that the quantities will be recovered.
- If probabilistic methods are used, there should be at least a **90% probability** that the quantities actually recovered will **equal or exceed the estimate**.

# SEC – “reasonable certainty”

- Ron Winfrey – May 2000

- “If a revision is needed in the future, and it always is, it will be much more likely to be an upward revision than a downward one.”
- “There is no distinction between the reasonable certainty needed for developed versus undeveloped reserves.”
- “All reserve estimates are interpretations of data. The more data you have the more certain you are of your estimate. Likewise, the less data you have, the less certain you are of your estimate.”
- “Therefore, to meet the requirement of reasonable certainty in situations with less data, such as PUDs, your estimate should be conservative to ensure any future revision will be positive rather than negative.”
- “Reasonable certainty is more than just the technical considerations that oil and gas is recoverable. It also includes resolution of how other barriers such as financial, environmental, marketing, legal and political will be overcome.”

# “Reasonable Certainty”

## Substantial Divergence of opinion in interpretation

- API-AGA 1946 – “every reasonable probability they will produce when drilled”
- API-AGA 1960 – “beyond reasonable doubt”
- API-AGA 1964 – “reasonable certainty”
- SPE/WPC 1997 – “90% probability reserves will exceed estimate”
- API-AGA 1966 – “can be reasonably judged as economically productive”
- US DOE/EIA 1979 – Same as API-AGA
- SEC – Currently – “high certainty that reserves will increase rather than decrease”



# SEC – “reasonable certainty”

## Reasonable Certainty Requirements for SEC Defense

1. Generated by supporting geological and engineering data.
2. Validation of assumptions are necessary.
3. Where supporting data is scarce and validation difficult, a conservative approach must be used until this data is available.
4. Concept - with validation, reserves should increase rather than decrease.
5. Analogy – Criteria for analogies should be equal to or better than referenced reservoirs used as analogies.





# SEC vs. SPE/WPC – “producibility”

## SEC 1996

- In certain instances, proved reserves may be assigned to reservoirs on the basis of a **combination** of electrical or other type logs **and** core analysis which indicate the reservoirs are analogous to similar reservoirs **in the same field** which are producing or have demonstrated the ability to produce on a formation test.

## SPE/WPC 1997

- In certain cases, proved reserves may be assigned on the basis of well logs **and/or** core analysis that indicate the subject reservoir is hydrocarbon bearing and is analogous to reservoirs **in the same area** that are producing or have demonstrated the ability to produce on formation tests.



# SEC vs. SPE/WPC – “Proved Area”

## SEC 1978

- The area of a reservoir considered proved includes:
  - (A) *that portion* delineated by drilling and defined by *gas-oil and/or oil-water* contacts, if any, and
  - (B) the *immediately adjoining* portions *not yet drilled*, but *which* can be reasonably judged as economically productive on the basis of available geological and engineering data.

## SPE/WPC 1997

- The area of the reservoir considered as proved includes:
  - (1) *the area* delineated by drilling and defined by *fluid* contacts, if any, and
  - (2) the *undrilled* portions *of the reservoir that* can reasonably be judged as commercially productive on the basis of available geological and engineering data.

# SEC vs. SPE/WPC – “Proved Area”

## SEC 1978 - log

- In the absence of *information* on fluid contacts, the lowest known *structural* occurrence of hydrocarbons controls the *lower* proved limit *of the reservoir*.

## SPE/WPC 1997 – combination of data

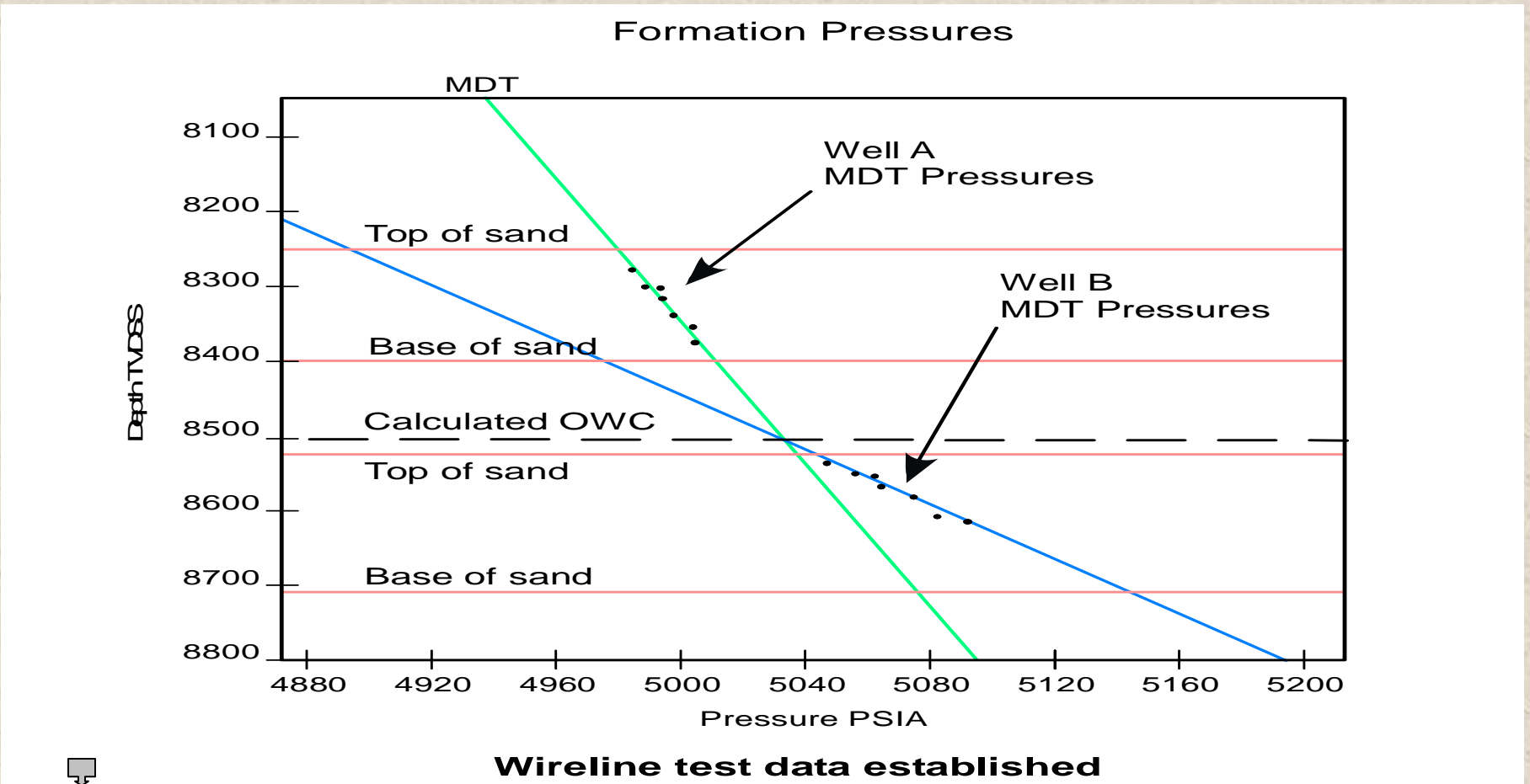
- In the absence of *data* on fluid contacts, the lowest known occurrence of hydrocarbons controls the proved limit *unless otherwise indicated by definitive geological, engineering and performance data*.



# SEC vs. SPE/WPC – “Proved Area”

## SIGNIFICANT DIFFERENCES IN SEC AND SPE / WPC RESERVES DEFINITIONS

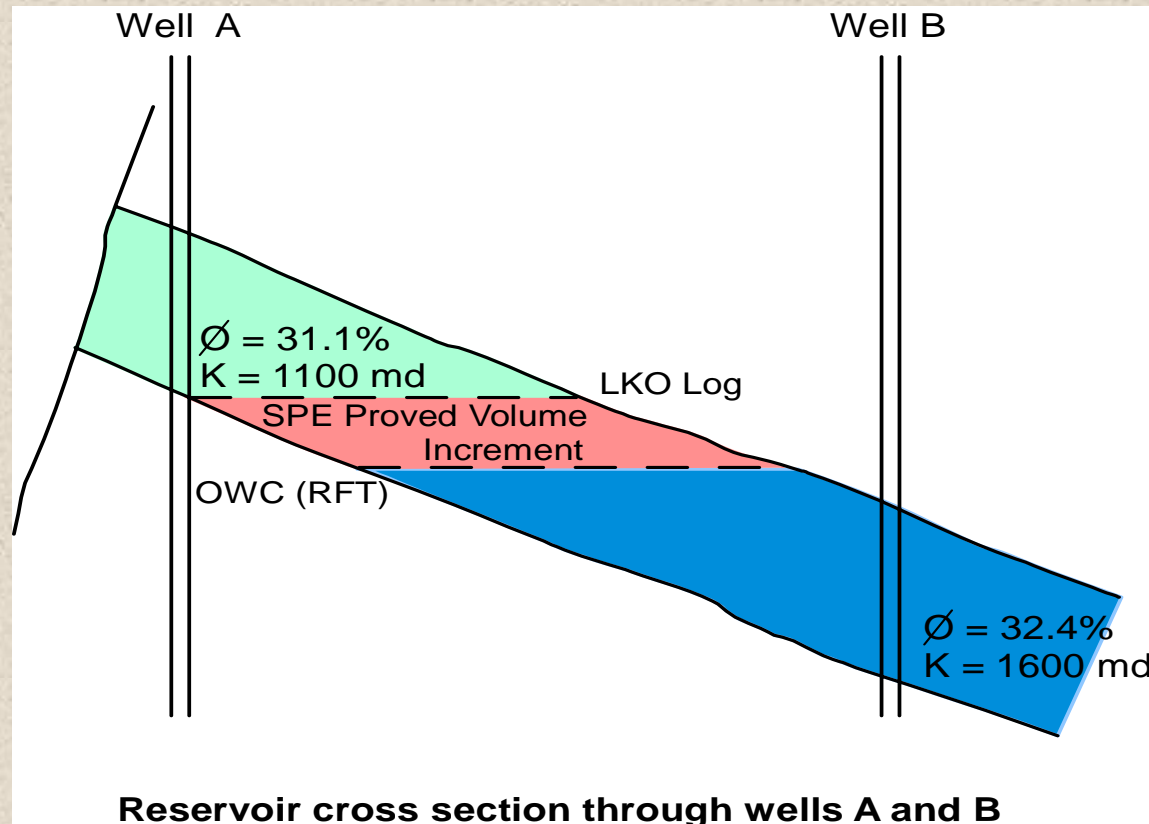
- Determination of Lowest-Known Hydrocarbons



# SEC vs. SPE/WPC – “Proved Area”

## SIGNIFICANT DIFFERENCES IN SEC AND SPE / WPC RESERVES DEFINITIONS

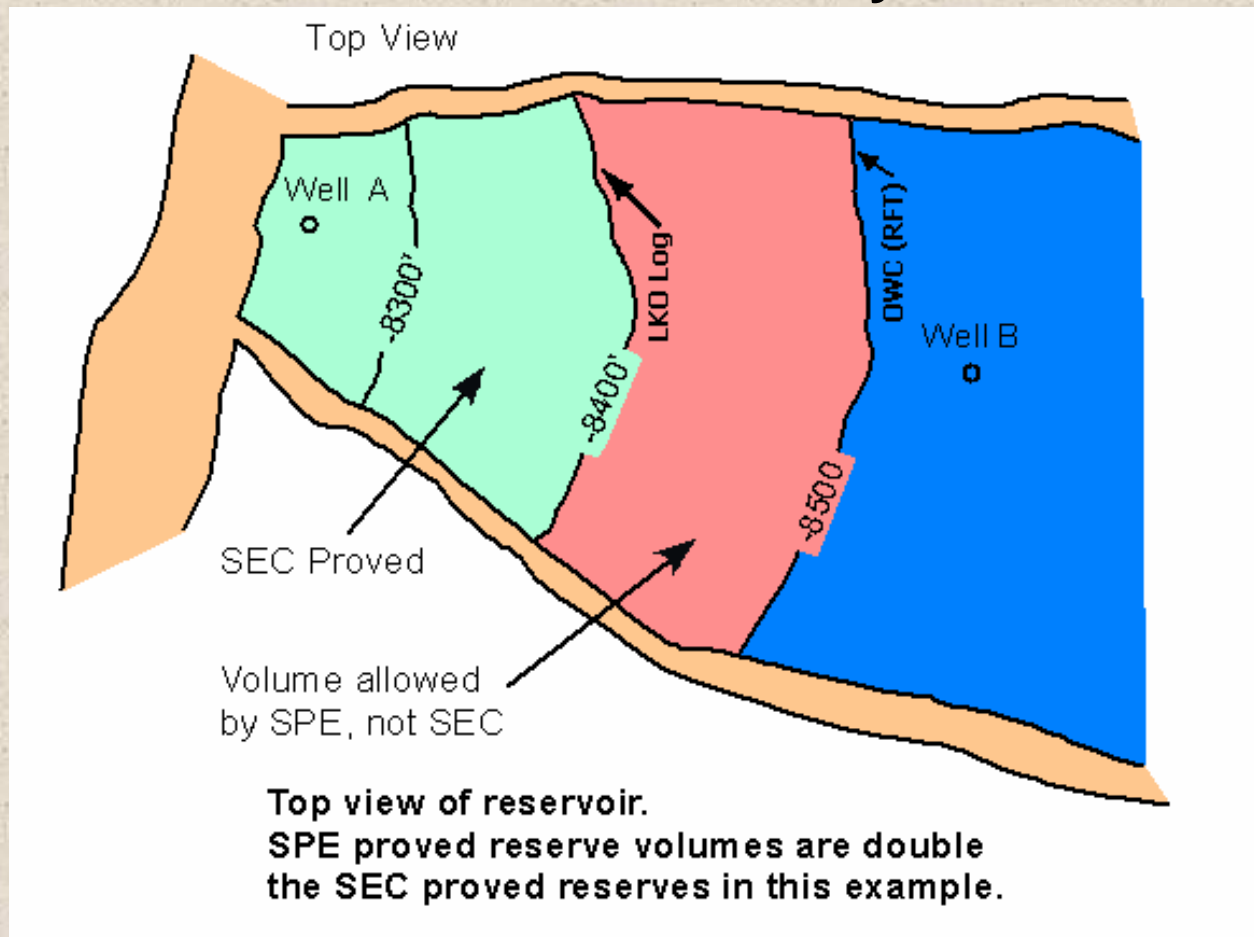
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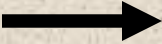
# SEC vs. SPE/WPC – “Proved Area”

## SIGNIFICANT DIFFERENCES IN SEC AND SPE / WPC RESERVES DEFINITIONS

- **Determination of Lowest-Known Hydrocarbons**



# Agenda

1. Introduction
2. Types of Reserve Estimates
3. SEC Proved Reserve Definitions
4. SPE/WPC Probable Definitions
5. SEC vs. SPE/WPC Reserve Definitions
-  6. **SEC Hot-Button Topics**
7. SEC Red Flag Items

# SEC Hot-Button Topics

- A. PUDs**
- B. Appropriate Reserve Calculation Methods**
- C. Recovery factors**
- D. Proper Use of Analogies**
- E. Reliance upon Seismic**
- F. Determination of LKH**
- G. Thickness**
- H. Areal Extent of Reserves**
- I. Reservoir Simulation**
- J. Flow Test Requirements**
- K. Prices**
- L. Revenue from Sale of Non-Hydrocarbons**
- M. Cased and Capped wells**
- N. Market Assurance**
- O. Plants**
- P. Ownership**
- Q. Net Profits Interest**
- R. Economic Limit**
- S. OPEX**





# SEC Hot-Button Topics - PUDs

## SEC TREND

(Ron Harrell – Internal Memo 9-22-2003)

- **“ The SEC position about PUD’s is unchanged. They seldom approve “offsets beyond one legal location” away from a commercial well and will not without convincing evidence about “certainty of production”.**
- **This is a tough standard that should not be contested without excellent reservoir data.”**

# SEC Hot-Button Topics - PUDs

## Questions to SEC, June 23, 2000

- **PUD in an upthrown fault block (undrilled) adjacent to a producing well, can you book proved reserves?**
  - Ans: Winfrey – **Not as proved**
- **SEC definition of proved reserves states that the area of a reservoir considered proved includes “the immediately adjoining portions not yet drilled...” Does this statement mean only one location away?**
  - Ans: Winfrey – **Yes, and only if you can show reservoir continuity.**
- **If a small company books a PUD, does the SEC care if they have never done anything that large before or may not be able to get the capital?**
  - Ans: Winfrey – **Yes!** We occasionally see a practice of delaying the production from a PUD 10 years in the future. It is hard to have anything reasonably certain 10 years from now. **You should be able to schedule development for it to be considered a PUD.**

# SEC Hot-Button Topics - PUDs

## More Questions to SEC, June 23, 2000

- Why does the SEC only allow one location offsets to be considered proved when there are numerous situations where the correlative zone is proven by production several locations away? Can reservoir performance be used to prove a larger reservoir than a spacing unit plus one offset?
  - Ans: Winfrey - "In general, "No!"
- How should we determine what distance and size represents a location or spacing unit in offshore areas like the GOM? What size does the SEC accept for a PUD location in a foreign field operated under a PSC?
  - Ans: Winfrey - "the technically justified drainage area would be the size of the next adjacent location."

(Note: Offset rule applies to most recently approved spacing.)



# SEC Hot-Button Topics - PUDs

## PUDS REVIEW

- One offset “rule” (regulatory spacing)
- Appropriate drainage area
- Significant capital
- Must have a definitive plan to develop
- No adjacent fault blocks without at least one productive well
- Will not accept similar seismic event
- Must have infrastructure in place or authorized & funded
- Must have a market
- Secondary recovery
  - Must have either successful pilot in field and reservoir, or
  - With proper documentation, analogy flood, with “similar” parameters



# SEC Hot-Button Topics

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# SEC Hot-Button Topics – Reserve Calculations

- **Volumetrics**

- Can be the best tool before any production occurs and if defined with enough control should not be ignored at any stage of depletion.

- **Decline Curve Analysis**

- Works in as short a time as 6 months production but best with long production history (several years). Definitely best in final stages of depletion.

- **Material Balance**

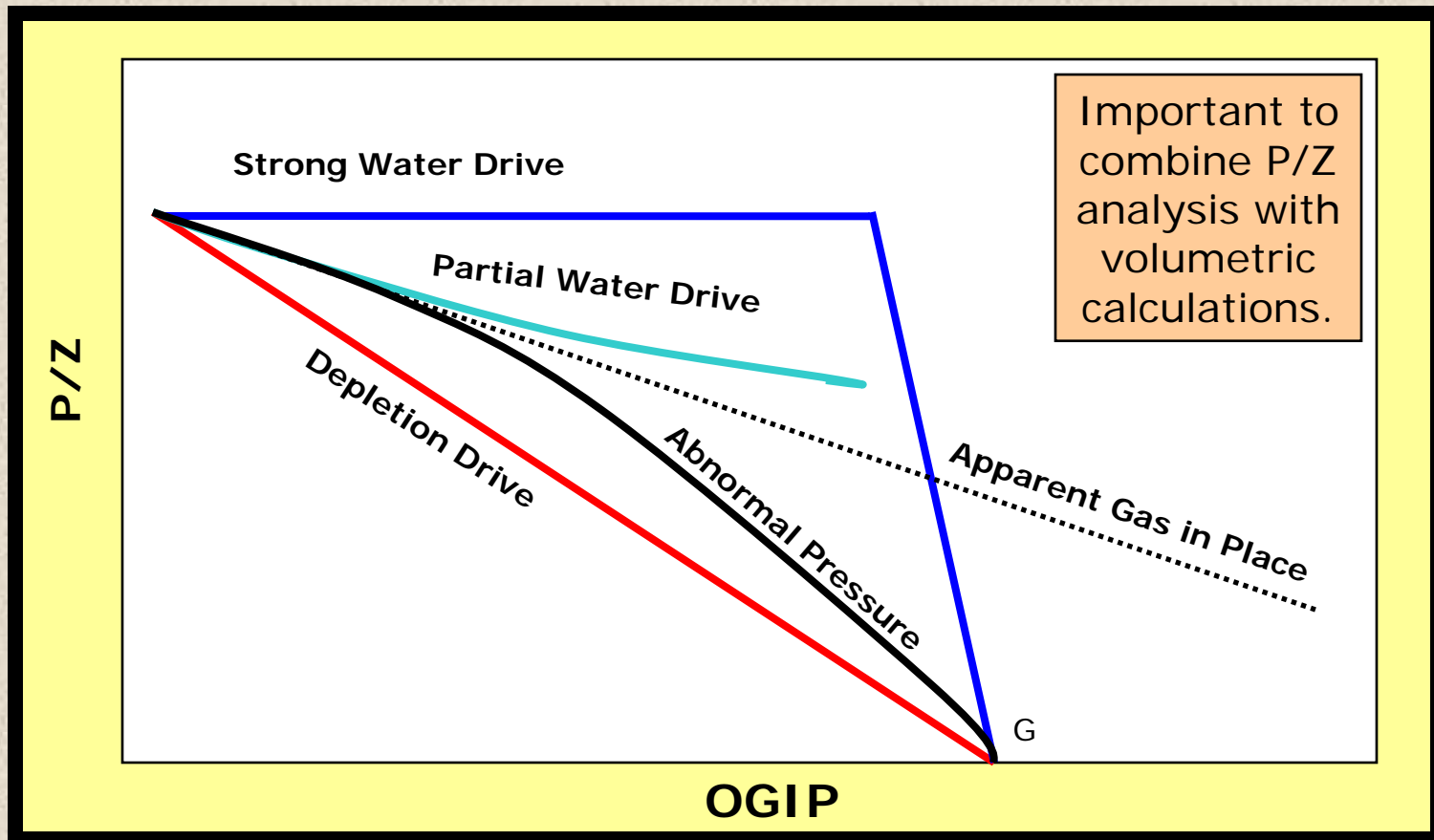
- Works best between 10% depletion and 70% depletion. Care should be exercised in late stages of depletion.

- **Analogy**

- Best in Blanket Sands
- Basis for infill statistical models
- Works Best before any production and where Volumetrics do not work.

# SEC Hot-Button Topics – Reserve Calculations – Material Balance

- Uncertainty with Standard P/Z



# SEC Hot-Button Topics – Reserve Calculations

- Overestimation by P/Z in Waterdrives or Abnormal BHP
- Overestimation by Decline Curves in strong water drives
- Overestimation using field level plots rather than well or reservoir
- Overestimation by Outdated Analogy in Infill Drilling
- Underestimation by Volumetrics with LKH



# SEC Hot-Button Topics

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# SEC Hot-Button Topics – Recovery Factors

## Recovery Factors – SEC Trend (Ron Harrell – Internal Memo 9-22-2003)

- “We are becoming aware of increased scrutiny by the SEC of recovery factors applied to volumetric reserves. Their position is that an evaluator should use a recovery efficiency for both oil and gas associated with **the most unfavorable drive mechanism unless there is information to the contrary**”.
- “Such information may be available through **analog**s, information about **aquifer size** or **other calculations** incorporating rock and fluid properties”.
- “Our estimates of recovery factors should, as always, be thoroughly documented in our work papers
- Staff pressing for hard evidence for r.f.’s higher than low-side of range
- SEC may ask for supporting documentation of assumptions
  - Examples:
    - water drive for oil
    - absence of water drive for gas
- **DOCUMENT YOUR ASSUMPTIONS**



# SEC Hot-Button Topics – Recovery Factors

- Based on expected drive mechanism – support expected
- Analogies of comparable production
- Reasonable assumptions for  $S_{or}$ ,  $S_{rg}$ , sweep,  $P_{abn}$
- Based on simulation only if good pressure and performance history match exists.
- Model “in-place volumes” limited by SEC
  - LKH limitations
  - Flow test requirements
  - SEC recognizes models often represent expected case



# SEC Hot-Button Topics

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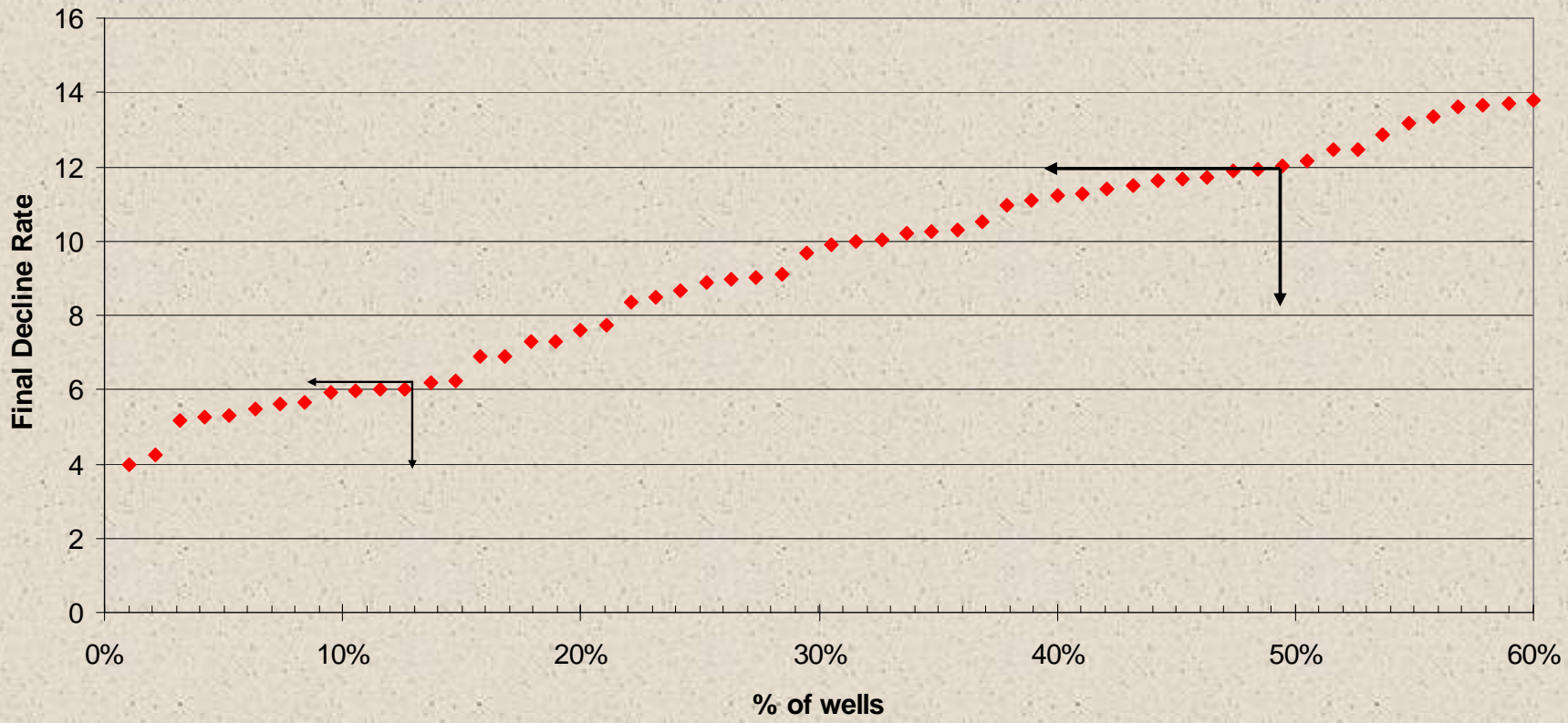
# SEC Hot-Button Topics - Analogies

- Apply knowledge gained from **analogous** and **mature** reservoir or recovery process to estimate the performance in target reservoir
- Mostly relied on **early** during the field life when **little definitive performance and/or geologic data is available**
- Also important when new recovery mechanism or enhancements are introduced to a field (e.g. waterflood, well stimulation)

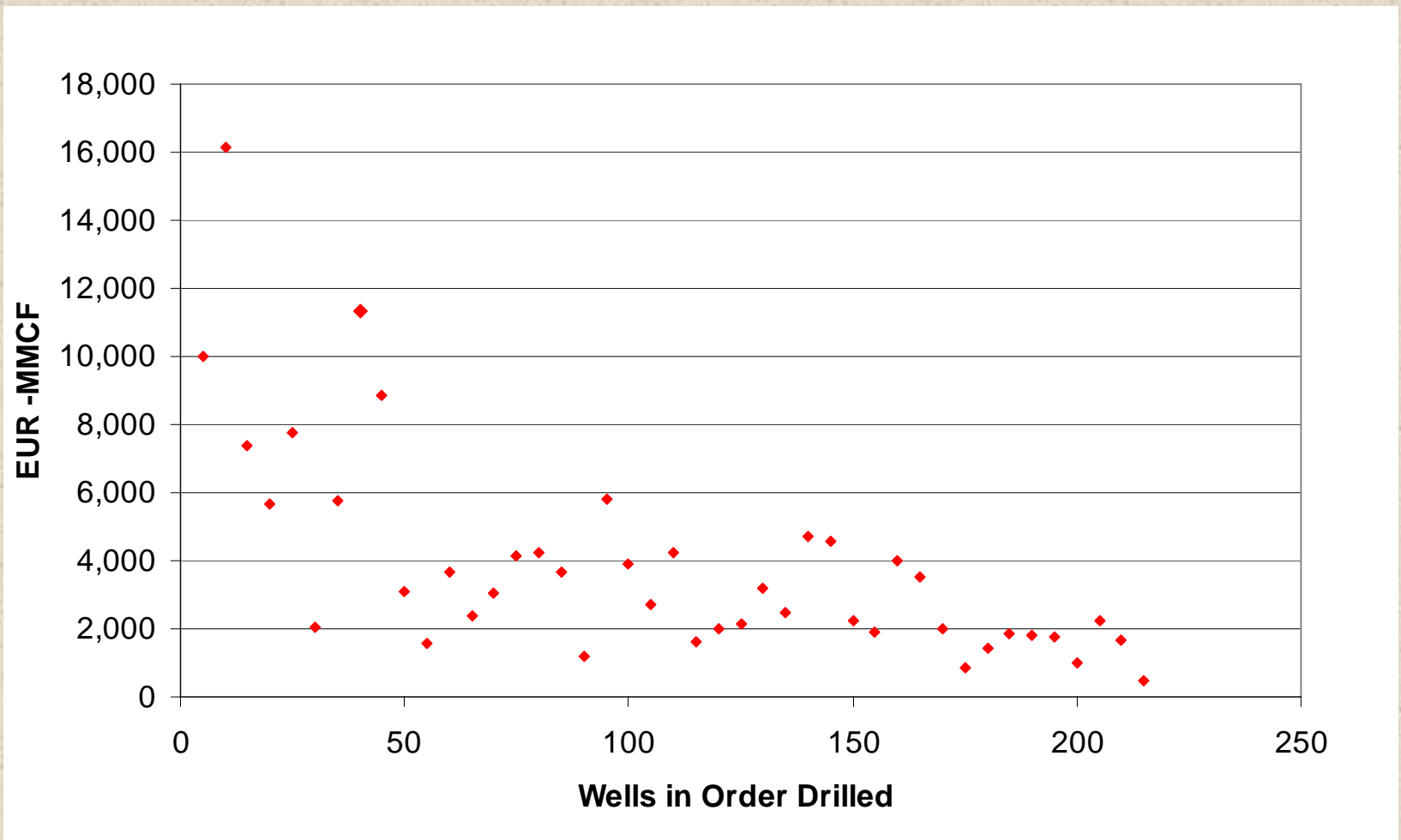
# SEC Hot-Button Topics - Analogies

- Performance of analogous wells or reservoirs used to determine:
  - Ultimate recovery per well
  - $D_{min}$
  - $P_{abn}$
  - GORs, Yield, Fluid Properties
  - Drainage & Well spacing
  - Expected Drive Mechanism
  - Recovery for a given drive mechanism:
    - per well
    - per acre-foot (RF)
    - cumulative injection volume

# SEC Hot-Button Topics – Analogies Dmin



# Ultimate Recovery Analogy





# SEC Hot-Button Topics - Analogies

- Proof of analogy
  - Establish proof that new reservoir is analogous to other more mature reservoirs
  - Rock and fluid properties of the target reservoir need to be equal or more favorable than the analogous reservoir in order to qualify for proven reserves

# SEC Hot-Button Topics - Analogies

- List of critical parameters for comprehensive review

<b><u>Geoscience</u></b>	<b><u>Engineering</u></b>	<b><u>Operational</u></b>
Structural configuration	Pressure and temperature	Well spacing
Lithology and stratigraphy	Fluid properties	Artificial lift methods
Principal heterogeneities	Recovery mechanism	Pattern type and spacing
Reservoir continuity	Fluid mobilities	Injector to producer ratio
Average net thickness	Fluid distribution	Annual injection volumes
Water saturation	Reservoir maturity	Fluid handling capacity
Permeability	Well productivity	Stimulation design
Porosity	EOR specifications	Areal proximity
Areal proximity	Areal proximity	

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# SEC Hot-Button Topics – Reliance on Seismic

## Questions posed to Ron Winfrey - SPEE Forum 2000

- Historically SEC has dismissed seismic alone as too uncertain for **proved** reserves classifications
- Extension below lowest known hydrocarbons?
  - **No!**
- Proving up nearby untested analog structures?
  - **No!**
- Proving up extensions within anomaly areas?
  - **No, unless supported by performance.**
- Use Seismic for increasing thicknesses beyond well control?
  - **No, too speculative**
- Classify Similar Undrilled Seismic Events as PUD?
  - **No!**



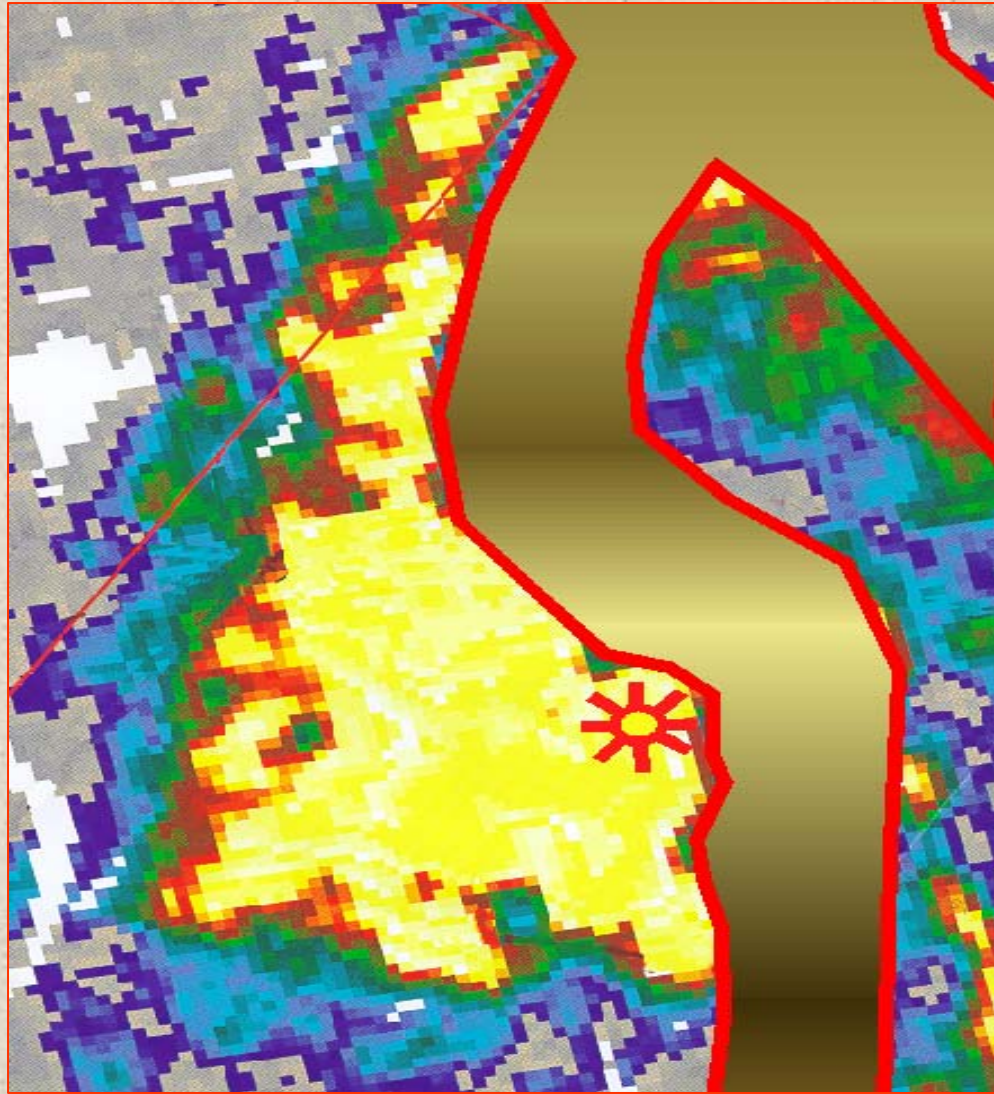
# SEC Hot-Button Topics – Reliance on Seismic

## When can we use seismic to increase proved reserves?

- Performance history and other supporting engineering data would be necessary such that a combination of seismic and engineering data would support the expanded down-dip limit of the reservoir
- Such evidence would have to be compelling for acceptance by the SEC
- Seismic data is not an indicator of continuity of production and, therefore, cannot be the sole indicator of additional proved reserves beyond the LKH established by a well penetration.
- The use of high-quality, well calibrated seismic data can improve reservoir description for performing volumetrics.
- Seismic can be used to show lateral extent of the reservoir above the LKH



# SEC Hot-Button Topics – Reliance on Seismic



# SEC Hot-Button Topics

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# SEC Hot-Button Topics - LKH

- SEC - well logs only
- SEC conservative position can lead to significant differences relative to SPE/WPC reserves as was shown earlier.
- Reversal of 2000 SPEE forum position – “compelling case”
- “There are obviously probabilistic estimates which would attribute reserves below LKH- they would say there is a finite probability of it, but we would not accept that.” *(Ron Winfrey-Sep. 2000)*





# SEC Hot-Button Topics

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# SEC Hot-Button Topics - Thickness

- Increased thickness based on Seismic?
  - **No!**
- Decreased thickness based on Seismic?
  - **YES ! Honor the Data**
- Limit maximum thickness to gross interval seen in actual penetrations
- Must have proof of structural gain to fill wet sand with hydrocarbons
- Properly walk the sand out of water from GWC or OWC
- Must also apply wedge to LKG or LKO if pay to base. **Conservative**



# SEC Hot-Button Topics

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# SEC Hot-Button Topics – Areal Extent

Use the most **technically supportable** area above the LKH that can be drained with the existing penetrations or defensible offset locations.

Demonstrate the ability to effectively drain the given drainage areas based on

Analogy to other wells,  
Radius of Investigation tests, or  
Reservoir models

# SEC Hot-Button Topics – Areal Extent

**In some cases technically defensible drainage area may be more or less than regulatory spacing area.**

**If the reservoir is developed on a regulatory spacing pattern, book the lesser of the regulatory area or the technically defensible drainable area.**

# SEC Hot-Button Topics – Areal Extent

If the area to LKH is unreasonably small, and other data indicates a larger reservoir, you can **make larger acreage assignments in some cases**. This should be supported by seismic, analogy, MDT data, RLI, and must be well documented. Be prepared to defend your work. This is **not an SEC policy** but they often **do not object** if well documented.

SEC comfort level

**40** acres for oil

**160** acres for gas

# SEC Hot-Button Topics

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# SEC Hot-Button Topics - Simulation

- **SEC Recognizes Models Often Represent Expected Case (PV+PB) or P<sub>50</sub>**
- **In-Place Proved Volumes Limited by SEC**
  - **LKH limitations**
  - **Thickness limitations**
  - **Flow test requirements**
- **SEC requires “Good History Match” with sufficient history to book proved reserves**



# SEC Hot-Button Topics - Simulation

- **What constitutes a “Good History Match”?**
  - **Model and Actual Field Data show matches in BHP and FTP data**
  - **Producing fluids match by well**
  - **Good match of material balance OGIP or OOIP to volumetric model**
  - **Producing Ratios match**
  - **The forecasted results are reasonable**

# SEC Hot-Button Topics - Simulation

- **Recovery Factors from expected model may be applied to proved volumetric in place estimates.**
- **Models may be used to support drainage area estimates**
- **Models may be used in combination with other estimates**

# SEC Hot-Button Topics

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# SEC Hot-Button Topics – Flow Test

- **Significant Unresolved Issue** – SEC Definition of “*conclusive formation test*” outside of the GOM
  - In certain areas – not seen as necessary or feasible
  - Producers reasons for no flow test in deepwater GOM
    - Data often sufficient without flow test
    - Redundancy to calculated test rates
    - Costs often exceed \$25MM (Up to \$100MM)
    - Delays of up to two years
    - Environmental concerns and permitting requirements
    - Test Equipment may not exist for certain conditions.
    - Unnecessary in many cases
    - Data from MDT often more useful



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# SEC Hot-Button Topics - Prices

- SEC pricing rules:
  - If contract, use until contract terminates
  - Hedging, unless property specific, is ignored
  - In case of absent spot market, must have signed sales contract
  - All prices need to be adjusted for quality and transportation
  - Prices at point of sales

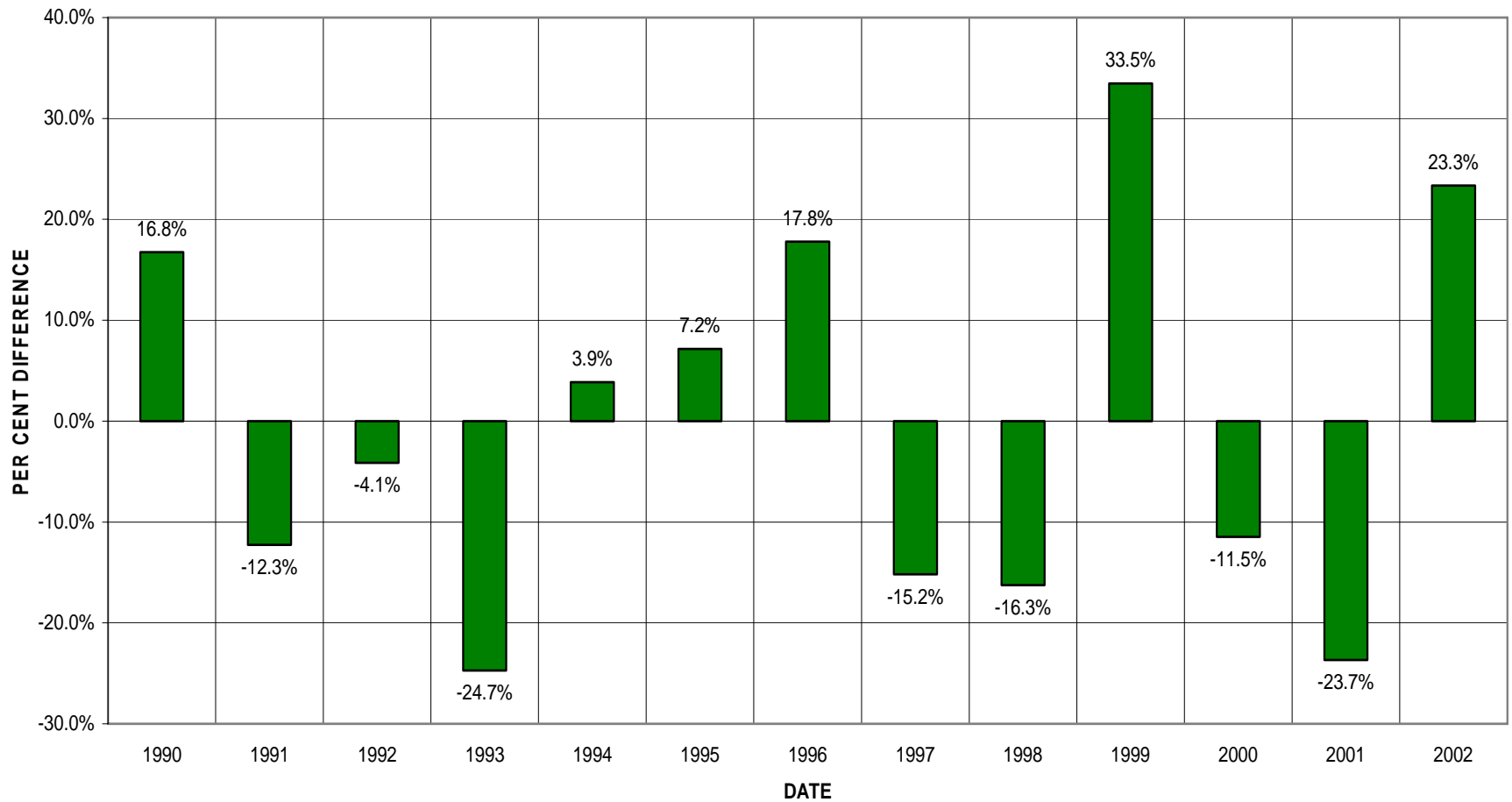
# SEC Hot-Button Topics - Prices

- **SPE/WPC** – allows some latitude, average period OK
- **SEC** – non-interpretative. **Must use price on effective date**
- Can lead to abnormally high (or low) economic well lives – Reserves yo-yo



# SEC Hot Button Topics - Prices

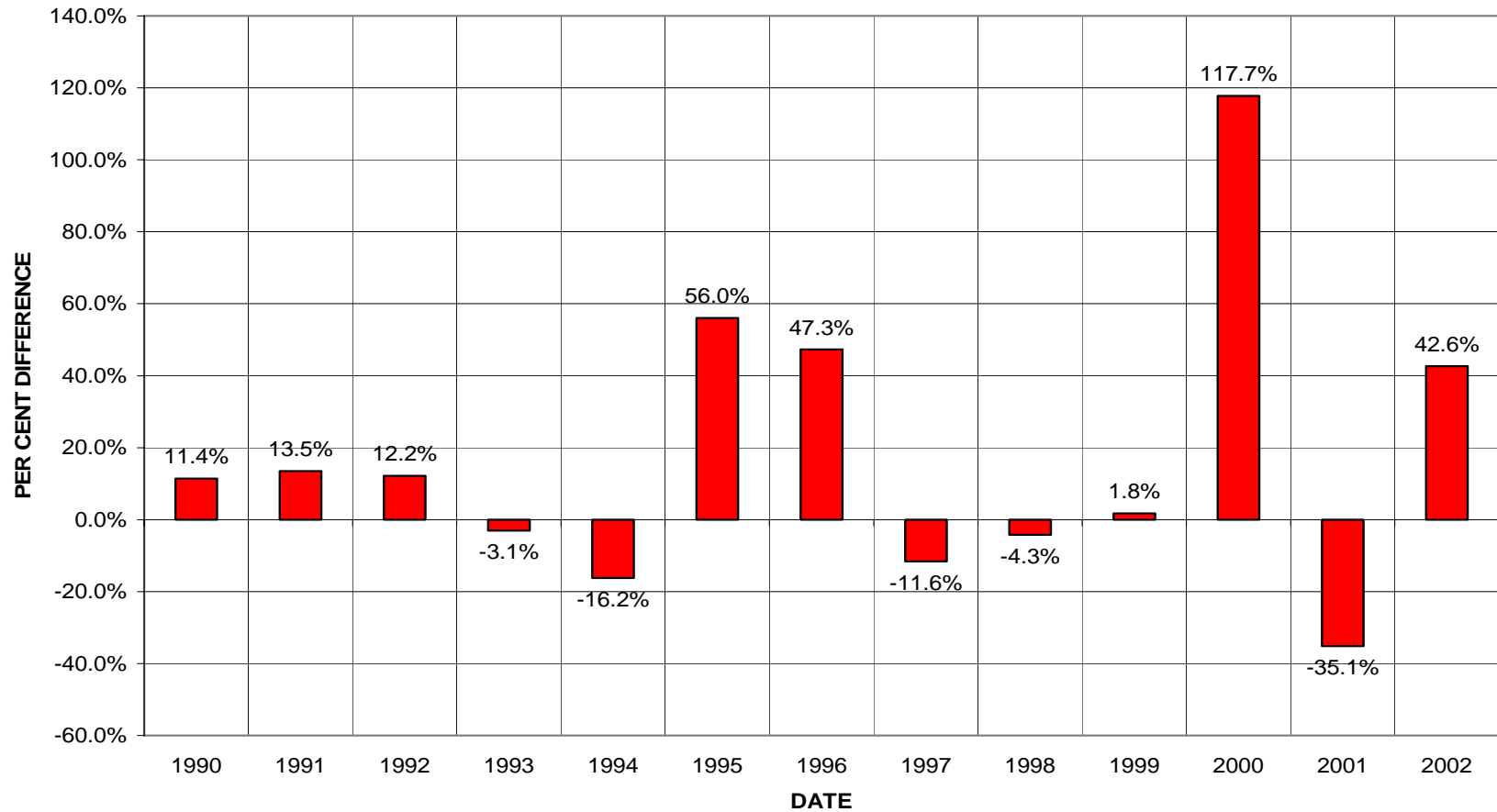
WTI OIL PRICES  
COMPARISON OF YEAREND PRICE TO ANNUAL AVERAGE PRICE





# SEC Hot Button Topics - Prices

**HENRY HUB GAS PRICE  
COMPARISON OF YEAREND PRICE TO ANNUAL AVERAGE PRICE**



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# SEC Hot-Button Topics

## Revenue from Sale of Non-Hydrocarbons

### SEC Trend

(Ron Harrell – Internal Memo 9-22-2003)

- “The SEC staffs demonstrates an unwavering stance on not reporting revenues from anything other than the sale of hydrocarbons and not using such “extraneous” revenues to offset operating costs.”



# SEC Hot-Button Topics

## Revenue from Sale of Non-Hydrocarbons

- **SEC Prohibits All Non-Hydrocarbon Reserves (including Sulphur , CO<sub>2</sub> , and Helium)**
- **3-5% non-hydrocarbon gas OK (immaterial)**
- **Third Party Processing Revenue excluded**
- **Cannot use processing income to offset or reduce operating costs**



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# SEC Hot-Button Topics

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## Cased and Capped Wells

If wells are drilled and left cased and capped, bookings are allowed if:

- a. Market is available
- b. Development plan included in budget plan
- c. Meets SEC proved criteria.

# SEC Hot-Button Topics

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# SEC Hot-Button Topics – Market Assurance

- Reserves which are economically producible under existing operating and economic conditions should be recorded as proved if in the foreseeable future a market will exist, as evidenced by negotiations with or announced plans by a transporter.
- If the market is intermittent, or if sales to the market are not continuous, only those portions of produced gas that can be reasonably certain of actual sales should be booked as proved reserves.
- Market must be established – Especially in frontier areas





# SEC Hot-Button Topics

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- F. Determination of LKH
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- H. Areal Extent of Reserves
- I. Reservoir Simulation
- J. Flow Test Requirements
- K. Prices
- L. Revenue from Sale of Non-Hydrocarbons
- M. Cased and Capped wells
- N. Market Assurance
- O. Plants**
- P. Ownership
- Q. Net Profits Interest
- R. Economic Limit
- S. OPEX



# SEC Hot-Button Topics - Plants

There is no ownership of NGL reserves that are the result of plant ownership

The ownership of NGL reserves must be taken back to the lease level for booking

If a plant keeps a percentage of the product in lieu of processing fees, that NGL reserve is neither owned by the plant nor the lease

A company may book “plant reserves” if they actually belong to the parent lease



# SEC Hot-Button Topics

- A. PUDs
- B. Appropriate Reserve Calculation Methods
- C. Recovery factors
- D. Proper Use of Analogies
- E. Reliance upon Seismic
- F. Determination of LKH
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# SEC Hot-Button Topics - Ownership

- A. Net Profits Interests**
- B. Production Payments**
- C. Plant NGL ownership**
- D. Gas Balancing**
- E. Stand-Out Penalties**
- F. Production Sharing**
- G. Processing**
- H. International – Contract Period**



# SEC Hot-Button Topics - Ownership

- Contract License Terms
  - Should not project reserves beyond remaining term of a contract or license unless the issuing body (country) has established a track record of doing so
  - Project Sanctioning must be approved
  - Internal / External approved plan of development.

# SEC Hot-Button Topics

- A. PUDs
- B. Appropriate Reserve Calculation Methods
- C. Recovery factors
- D. Proper Use of Analogies
- E. Reliance upon Seismic
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- P. Ownership
- Q. Net Profits Interest**
- R. Economic Limit
- S. OPEX



# SEC Hot-Button Topics - NPI

- For properties subject to payment of net profits, SEC requires property owner to deduct NPI “reserves” from owned reserves when filing SEC 10K.
- Recently, SEC has allowed receiving party to book NPI reserves
- SPE/WPC definitions – silent, but tradition considers NPI’s to be **financial** transaction without reserves ownership

# SEC Hot-Button Topics

- A. PUDs
- B. Appropriate Reserve Calculation Methods
- C. Recovery factors
- D. Proper Use of Analogies
- E. Reliance upon Seismic
- F. Determination of LKH
- G. Thickness
- H. Areal Extent of Reserves
- I. Reservoir Simulation
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- K. Prices
- L. Revenue from Sale of Non-Hydrocarbons
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- N. Market Assurance
- O. Plants
- P. Ownership
- Q. Net Profits Interest
- R. **Economic Limit**
- S. OPEX





# **SEC Hot-Button Topics – Economic Limit**

**Reserves do not exist when the annual cash flow for a given well, lease, or field, goes negative and stays negative.**

**A new well, BP zone, or project can only be booked if the cost forward economics are at least + \$1.00 undiscounted, including any new abandonment obligations.**

**Some projects may start negative and then turn positive but still show a profit for the entire project. (Waterfloods, Platforms, etc.)**

**An existing entry can be negative if the negative is caused by abandonment costs.**

# SEC Hot-Button Topics

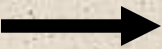
- A. PUDs
- B. Appropriate Reserve Calculation Methods
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- S. OPEX**



# SEC Hot-Button Topics - OPEX

- Not defined by statute but must make reasonable attempt to capture all costs related to production.
- Generally the average of past actual costs
- Fixed & Variable Components are OK
- Known reductions may be taken into account
- May exclude *real* non-recurring charges
- Non-operators must include COPAS as cost,
- Operators cannot include COPAS as revenue or offset to OPEX.
- Must include appropriate overhead charges

# Agenda

1. Introduction
2. Types of Reserve Estimates
3. SEC Proved Reserve Definitions
4. SPE/WPC Probable Definitions
5. SEC vs. SPE/WPC Reserve Definitions
6. SEC Hot-Button Topics
-  **7. SEC Red Flag Items**

# SEC Red Flag Items - PUDs

- Large Percentage of PUDs
- “Stale” PUDs
  - PUDs Remain Undrilled
  - Analogy for PUD no longer valid



# SEC Red Flag Items

- **Reserves audits by SEC may be triggered by:**
  - **History of downward reductions**
  - **By press releases**
  - **Response to Comment Letter**
  - **Annual reports that don't conform to press releases**
  - **Partner Activity, press releases, or revisions**
  - **A history of SEC infractions**
  - **Negative publicity**
  - **The Calendar – Every 3 years**
  - **Unusual Stock Volume or Movement**
  - **“Whistle blowers” or**
  - **for several other reasons.**

# What happens if I break the Rules?

## *REWARD*

A certificate of appreciation in a handsome plastic frame

## *RISK*

Public humiliation, loss of millions for shareholders, civil penalties, and possible time in a federal gated community

# SEC RESERVE BOOKING PRINCIPLES



**NOW YOU KNOW THE  
REST OF THE STORY**



## QUESTIONS ?

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