

CONSOLIDATED OIL & GAS REVIEW REPORT

2004 REPORT

February 2005

A|S|C
Alberta Securities Commission

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This is the first year that the Alberta Securities Commission has conducted its review of the quality of oil and gas disclosure of Alberta reporting companies.

For this report, the ASC reviewed filings received during 2004 from a sample of 236 companies of various sizes headquartered in Alberta.

OVERVIEW

The Alberta Securities Commission and other members of the Canadian Securities Administrators adopted National Instrument 51-101 Standards of Disclosure for Oil and Gas Activities (NI 51-101) effective September 30, 2003. NI 51-101 requires reporting issuers with oil and gas activities to file prescribed disclosure - Form 51-101F1 Statement of Reserves Data and Other Information, Form 51-101F2 Report of Independent Qualified Reserves Evaluator or Auditor, and Form 51-101F3 Report of Management and Directors - for financial years ending on or after December 31, 2003. This disclosure is to be filed by the date on which the issuers are required to file their annual audited financial statements.

In April 2003 the ASC established an in-house Oil & Gas Division to review underlying reserves evaluation reports and to provide technical expertise with respect to reserves evaluations. Staff have been reviewing the new filings required by NI 51-101 to ensure compliance with the requirements of that rule.

The purpose of NI 51-101 and the goal of these compliance reviews is to improve the quality, completeness and timeliness of reserves information available to the financial markets. This report summarizes the findings of staff concerning both filed disclosure and the more technical aspects of the underlying reserves evaluation reports.

Staff performed a preliminary review of the NI 51-101 filings of Alberta-based oil and gas issuers in 2004. This preliminary review of 236 issuers identified 14 issuers with material filing deficiencies, including:

- ▶ filing the full reserves evaluation report but not the Form 51-101F1 Statement of Reserves Data and Other Information;
- ▶ failing to file Form 51-101F2 Report of Independent Qualified Reserves Evaluator or Auditor, Form 51-101F3 Report of Management and Directors, or both; and
- ▶ not including the appropriate signatures on Form 51-101F2 or Form 51-101F3.

Staff followed up by performing detailed reviews of the NI 51-101 filings of the 14 issuers. Thirteen of the 14 reviews have been completed. In each of those 13 cases, the issuer identified as deficient had to amend and re-file its NI 51-101 disclosure documents.

OIL & GAS DIVISION REVIEWS

From April 2003 to September 2004 the Oil & Gas Division reviewed reserves evaluation reports for 91 public issuers of various sizes to determine whether appropriate reserves evaluation techniques were used and appropriate conclusions drawn. Staff requested additional supporting data and analysis from the issuers when it was not clear that either the techniques or conclusions were correct.

The most common concerns that staff identified with reserves estimations were:

- ▶ overestimation of drainage areas;
- ▶ inappropriate or unsupported production decline extrapolation;
- ▶ inappropriate or unsupported material balance estimates;
- ▶ poorly developed or biased use of Analogs; and
- ▶ incorrect use of terminology and notation.

When issuers were not able to satisfy staff's concerns about reserves evaluation reports, staff required the issuers to correct their reports.

COMMUNICATION / IMPLEMENTATION

Part of the ASC's role in implementing NI 51-101 included communicating interpretations and expectations to the industry. This was accomplished through:

- ▶ publication of CSA Staff Notice 51-313 Frequently Asked Questions - National Instrument 51-101 Oil and Gas Disclosure;
- ▶ responding to public inquiries; and
- ▶ staff speaking to the media and at numerous oil and gas conferences.

CONCLUSION

Overall, staff believe that the majority of issuers have complied with the NI 51-101 filing requirements, and that the majority of issuers reserves evaluation reports meet acceptable technical standards. Staff will continue to review and monitor both the NI 51-101 filings and the underlying reserves evaluation reports, and will follow up with the issuers when deficiencies are identified.

NATIONAL INSTRUMENT 51-101 FILINGS REVIEWS

INTRODUCTION

In 2004 staff implemented a screening process for oil and gas issuers required to comply with National Instrument 51-101 Standards of Disclosure for Oil and Gas Activities (NI 51-101). This preliminary review process enabled staff to identify materially deficient oil and gas disclosure. Staff communicated the deficiencies to the issuers and required the disclosure to be amended and re-filed. The preliminary reviews also enabled staff to compile issuer-specific information, such as quantity of reserves and magnitude of technical revisions. This information is stored in a database that will facilitate future comparative analysis.

In addition to the preliminary reviews, staff performed detailed reviews of 55 NI 51-101 filings. Twenty-nine of these filings were reviewed in conjunction with the review of a prospectus or an annual information form (AIF). In most cases, staff comments led to minor changes to the oil and gas disclosure in the final document. Out of the 29 filings, seven were materially deficient as described below and required previously filed oil and gas disclosure to be restated. Twelve of the NI 51-101 filings were reviewed in conjunction with general continuous disclosure (CD) reviews. Out of the 12, five issuers had to amend and refile their NI 51-101 disclosure. Fourteen of the filings were chosen based on staff concerns arising from the preliminary reviews. Of those 14, 13 files have been completed. All 13 issuers had to amend and refile their NI 51-101 disclosure.

Generally, the intermediate and larger issuer filings were in accordance with NI 51-101. The majority of the materially deficient filings came from very small issuers. Material deficiencies included omission of data and inconsistencies with the form requirements, including some issuers that failed to file any of the three required forms. Issuers with deficiencies that were not required to re-file provided a commitment to make specific disclosure improvements in their next year's filing.

Staff's conclusion is that the majority of NI 51-101 filings met the requirements, especially among the intermediate and larger issuers.

REVIEW SUMMARY

	<u>Total</u>	<u>Required to refile</u>
Preliminary reviews	236	
Detailed reviews	55	25
<i>Detailed reviews in connection with:</i>		
• the review of a prospectus or AIF	29	7
• a general CD review	12	5
• concerns arising from the preliminary reviews	14	13

1. OVERVIEW OF REVIEW PROCESS

i. Preliminary Reviews

This was the first year in which oil and gas reporting issuers were required to comply with NI 51-101. To ensure the new requirements were being met, or that appropriate action could be taken in a timely manner if the requirements were not being met, staff performed preliminary reviews of NI 51-101 filings by Alberta-based oil and gas issuers. To date, 236 preliminary reviews have been performed.

Staff identified all Alberta oil and gas reporting issuers from the SEDAR profile information. These issuers were entered into a database to facilitate proper tracking and documentation of the reviews. Staff followed standardized preliminary review procedures. One component of the review requires staff to summarize the following information, by issuer:

- ▶ proved undeveloped reserves;
- ▶ total proved reserves;
- ▶ total probable reserves;
- ▶ total possible reserves; and
- ▶ technical revisions, in total and on a percentage basis.

Staff also verified that all required NI 51-101 disclosure was filed. Any deficiencies were noted and documented in the database.

ii. Analysis and Sample Selection

Staff then reviewed the disclosure deficiencies noted in the database and selected 14 issuers that appeared to have material deficiencies, such as:

- ▶ some of the smaller issuers inappropriately filed full reserves evaluation reports in lieu of the required NI 51-101 Statement of Reserves Data and Other Oil and Gas Information;
- ▶ some issuers omitted the Report on Reserves Data by Independent Qualified Reserves Evaluator, or the Report of Management and Directors on Oil and Gas Disclosure, or both; and
- ▶ some issuers did not provide the appropriate signatures or dates on the latter two reports.

Staff reviewed the NI 51-101 filings for these 14 issuers and ensured that material deficiencies identified in the preliminary review were rectified. Of the 14 reviews, 13 have now been completed. All 13 issuers were required to amend and re-file the NI 51-101 disclosure.

Data from the preliminary reviews were also provided to the Oil & Gas Division, which uses the data to determine whether an issuer's underlying reserves evaluation reports should be subject to a detailed review. When staff are assigned an AIF, an offering document, or a general CD review of an oil and gas issuer, they inquire whether the Oil & Gas Division proposes to review the underlying reserves evaluation report. If so, completion of the AIF, offering document or CD review will require satisfactory resolution of all reserves evaluation report comments raised by the Oil & Gas Division.

iii. Full Reviews

When reviewing oil and gas disclosure, staff ensure the disclosure meets the requirements of NI 51-101 and the related forms. If deficiencies are noted, staff send a comment letter to the issuer addressing omissions from the requirements, inconsistencies among information in the NI 51-101 filings and other continuous disclosure filings, and disclosure deficiencies that warrant revisions or disclosure of additional information. Based on the response from the issuer, staff will assess whether the deficiencies are material and require restatement of NI 51-101 disclosure, or whether they require only a commitment from the issuer to make revisions in the next year's filings.

To date, the staff have reviewed NI 51-101 disclosure from 55 issuers. Forty-one of these were in connection with the review of a prospectus, or AIF or a CD review.

iv. Other Review Processes

Staff perform full reviews of NI 51-101 filings in conjunction with the review of a prospectus, an AIF or other offering documents, and CD reviews. Comments on the NI 51-101 information included in an offering document or AIF normally result in immediate revisions to that information.

2. RECURRING DEFICIENCIES

i. Omissions

In addition to the material omissions noted above under Analysis and Sample Selection, staff noted the following recurring omissions:

- ▶ failure to disclose the information required under Items 5 and 6 of Form 51-101F1 relating to undeveloped reserves, abandonment and reclamation, exploration and development activities, production estimates, and production history;
- ▶ failure to file a press release on SEDAR to announce that the NI 51-101 disclosure was included in the issuer's AIF;
- ▶ failure to disclose the weighted average historical prices for the most recent financial year in accordance with Item 3.2 (b) of Form 51-101F1;
- ▶ failure to include the required cautionary statement regarding barrel of oil equivalents (BOEs), as required by Part 5.14(d) of NI 51-101; and
- ▶ failure to include the cautionary statements regarding finding and development cost calculations, as required by Part 5.15(b)(iv) of NI 51-101.

ii. Inconsistencies

Staff noted the following inconsistencies in a number of filings:

- ▶ the total future net revenue value calculated with forecast pricing appears three times in Form 51-101F1 and once in Form 51-101F2. This number was not always internally consistent;
- ▶ a negative technical revision in the reserves reconciliation was sometimes disclosed as having a positive effect in the future net revenue reconciliation;
- ▶ reserves reconciliation requires separate disclosure of technical revisions and improved recovery. Often issuers combined technical revisions with infill drilling and reported the net effect as a technical revision. This is inconsistent with the requirements; and
- ▶ NI 51-101 requires reserves information as at the last day of the issuer's most recent financial year. In a number of cases, issuers used "price decks" reflecting forecasts at a date much later than their financial year-end, but omitted the year-end price forecasts.

iii. Other Disclosure Deficiencies

Staff noted several instances of the following disclosure deficiencies:

- ▶ issuers included blanket disclaimers indicating that they could provide no assurance that the indicated reserves would be recovered. This is in direct contradiction to the proved and probable reserve definitions;
- ▶ item 5.2 of Form 51-101F1 requires disclosure of specific factors of uncertainty that may affect an issuer's reported reserves. Instead, issuers disclosed the general risks involved in evaluating reserves, highlighting the fact that reserves values are only estimates;
- ▶ issuers that reported material negative or positive technical revisions to prior year reserves estimates failed to disclose the reasons or causes for the material revisions; and
- ▶ many issuers with calendar financial years incorrectly dated the NI 51-101 information as at January 1, 2004, but it is required to be as at their financial year end. In addition, most of the issuers failed to disclose the preparation date of the Form 51-101F1.

3. CONCLUSION

Overall, staff believe that the majority of the issuers have complied with NI 51-101, especially the intermediate and larger issuers. Staff have noted a heightened awareness of NI 51-101 among investors, and a better understanding of the requirements and interpretation of NI 51-101 among industry professionals. High quality oil and gas disclosure aims to provide investors with better information upon which to make investment decisions, and should thereby enhance the ability of oil and gas issuers to raise capital.

OIL & GAS DIVISION REVIEWS

INTRODUCTION

In 2003, the Alberta Securities Commission established an in-house technical staff, consisting of an engineer and a geologist, both with many years of experience in reserves evaluation. An oil and gas technician was added in the third quarter of 2004.

Duties of the Division include:

- ▶ advising the Commission on technical aspects of oil and gas matters;
- ▶ reviews of technical aspects of oil and gas disclosures, reserves evaluation and Form 51-101F1 oil and gas disclosure statements;
- ▶ support for Enforcement activities;
- ▶ support for the implementation of, and assessing conformity to new NI 51-101 and the Canadian Oil and Gas Evaluation Handbook (COGEH) which is incorporated by reference into NI 51-101; and
- ▶ communication to the public on oil and gas disclosure matters. Staff have made presentations at various technical conferences, published papers, and continue to respond to numerous inquiries.

1. OIL AND GAS RESERVES DISCLOSURE REVIEWS

Systematic staff review of reserves disclosure information started in April 2003. In the last three quarters of 2003, reserves information from 43 issuers, and in the first three quarters of 2004, 48 different issuers, was reviewed. Most of the properties examined were in the West Canadian Basin (WCB). Most of the reserves estimates used in the evaluations used production decline forecasting, a considerable number were volumetric, and a few used material balance. Simulations were used in a small number cases, but usually in support of estimates made using other methods.

Reserves evaluations by about 20 different evaluation firms were examined, although five major companies carried out most of them. Most firms were Canadian, three were from the USA, and a couple were from other countries.

The depth of review that is carried out varies considerably, from that required to answer relatively simple questions, to the considerably more extensive work on systematic reviews or monitoring. Review procedures are still under development, and in particular, an effort is being made to systematize the initial stages of a review.

Reviews were carried out for a variety of reasons:

a. Referrals from the Securities Analysis Division

Most of the reviews carried out to date have been in conjunction with a general CD review or the review of an AIF or an offering document. As a result of the review, comments were often made and questions asked about reserves, which resulted in clarification and the provision of additional information and, in some cases, amendment of the reserves evaluation report and the prospectus.

b. Systematic Reviews

There are over 250 public oil and gas issuers in Alberta, but the list is not static, and there is considerable variation in issuer size. We intend to review the reserves disclosure of all of them over time. Issuers can be chosen for review at random, but previous experience with an issuer's reserves evaluation reports and its history of reserves revisions, and with the evaluator, can also be factors. Exemption from the requirement for independent reserves evaluations, or allowing an issuer to report using US requirements, is not an exemption from review under this program.

c. Monitoring Reviews

If there are concerns about a reserves evaluation report, it may be put on a list for monitoring. This consists primarily of a review at a later period, when additional production or drilling information is available to assess the validity of predictions that have been made.

d. Enforcement Support

The Oil and Gas Division provides support and advice to the ASC Enforcement Division as required.

2. ISSUES ARISING FROM REVIEWS

a. Volumetric Reserves Estimates

The two most important parameters in volumetric estimation are generally the recovery factor and the drainage area. There are often many analogs for the recovery factor, but there is usually limited information on which to base an estimate of drainage area, and thus drilling spacing units or fractions of drilling spacing units are commonly used. For the types of reservoir that are common nowadays, drainage areas assigned in this manner are often overestimated, resulting in a write down of reserves at a later date. There is no relationship between drilling spacing units and physical drainage areas, and greater consideration should be given to the areas that are assigned.

Staff may ask for technical support for the drainage areas that have been assigned in a volumetric evaluation.

b. Production Decline Extrapolation

Production decline extrapolation is the most common method of estimating reserves in the WCB. Subsequent reviews have shown that actual production is often less than forecast, even within a relatively short period of time. Problems identified include:

- ▶ Extrapolations carried out on data with little or no evident trend. Production decline extrapolation requires that there is a evident declining rate of production over a sufficient interval for a trend to be established.
- ▶ Insufficient differences between proved and proved + probable reserves. Differences should increase with:
 - data scatter
 - length of extrapolation

A number of reserves evaluation reports have been seen which contain extrapolations showing considerably less difference between proved and proved + probable forecasts, as much as 20 years into the future, than the variance in actual historic production.

- ▶ Selective use of data. Extrapolations should use all relevant decline data, but it is not unusual for them to be made using only the last few points. This appears to be more common when these last few points are at a higher rate or suggest a lower rate of decline than the full data.
- ▶ The assumption that a higher rate of a few recent points is sustainable, rather than being due to acceleration. In general, until there is sufficient data or other evidence to confirm a sustainable higher trend, the default assumption should be one of acceleration of production.
- ▶ The use of a best-fit line (usually a regression) to estimate proved reserves, with proved + probable reserves as an upside case. However, by definition, a best-fit line provides an estimate of a mean and is an approximation of a median, or P50, Proved + probable value, that is, a "best estimate", not an upside value. Only when there is very little scatter of the production data or a very limited extrapolation, might a best-fit line provide a direct estimate of proved reserves. In most cases, proved reserves are less than provided by a best-fit line, by an amount that depends on the quality of the data and the length of an extrapolation.
- ▶ It is inappropriate to always assume hyperbolic decline to be the default case. When it is used, it should be supported by a technical rationale, either directly by the data, or by valid analog well performance. Staff have a concern about overly aggressive ("hockey stick") hyperbolic decline extrapolations that are inconsistent with historic production.

Staff may request additional supporting data and analysis for production decline extrapolations that appear to be inconsistent with historic production data or to be overly aggressive.

c. Material Balance (p/Z)

Concerns with material balance (p/Z) estimates of gas reserves include:

- ▶ Failure to confirm that material balance is a suitable technique for the gas reservoir being evaluated, generally the default assumption that there is no pressure support. Significant errors can occur if material balance is used in reservoirs in which there is pressure support, and even the fact that the data falls on a straight line is no guarantee that there is no pressure support.
- ▶ Inadequate analysis of data before carrying out an extrapolation:
 - scattered data ("shotgun" pattern) often without any evident trend;
 - inconsistent data (e.g., a higher pressure in a partially depleted reservoir than the initial pressure);
 - failure to calculate the average reservoir pressure properly;
 - inadequate pool delineation, resulting in the combination of data from separate pools; and
 - poor-quality pressure measurements.
- ▶ Failure to recognise the consequences of extrapolating limited data. Considerable caution is required when carrying out a material balance estimate in reservoirs with low degrees of depletion. When there are only one or two data points close to the y-axis, an extrapolation is very sensitive to minor errors in the pressure, and there should be a considerable difference between extrapolated proved and proved + probable reserves.

- ▶ Use of a best-fit line to directly estimate proved reserves is justified only if there is adequate data with little scatter. A best-fit line provides an estimate of proved + probable reserves, and proved reserves should be less than this by an amount that depends on the quality of the data and the extent of extrapolation.

Staff may request additional supporting data and analysis of material balance evaluations.

d. Analogs

The selection and use of analogs is one of the most important parts of an evaluation. They are more widely used than is generally recognised, and are particularly important to both the volumetric and production decline estimation methods. However, they are often poorly developed, or are biased towards the best wells in an area instead of being representative. They:

- ▶ should be selected as being representative of the evaluation;
- ▶ should be weighted according to quality, recognising that perfect Analogs are rare to non-existent; and
- ▶ usually provide a proved + probable analogy and a further step is required if proved reserves are being estimated.

Staff may request additional detail on analogs when reviewing a reserves evaluation report.

e. Unrealistic Timetables

A number of cases have been seen in which the timetable of future exploration and development activities is overoptimistic, and only a limited number of the predicted activities have been carried out. Even if the delayed activities are eventually carried out in later years, there is an impact on the predicted cash flow.

f. Inadequate Explanation

There is considerable variation in the amount, quality, and relevance, of explanation in reserves evaluation reports, and some contain no explanation at all. There should be sufficient information in a report to understand how critical parameters have been developed, and it should be relevant. For instance, a report may contain an elaborate description of regional geology that is of limited relevance, but fail to explain how critical analog data has been developed.

Staff may request additional explanation.

g. Report Dates

Reserves evaluation reports are done at a specific "as-of" date, typically to coincide with the financial year end of an issuer. Information in the report should be up to that date, and product prices and price forecasts should be as at that date. If there are material events after the "as-of" date, they can be included as supplemental information, or included in a material change report filed with the regulators.

Reserves evaluation reports and NI 51-101 filings should report year end reserves at the issuer's year end, for example December 31 (not at January 1 of the following year).

h. Mechanical Updates

So-called "mechanical updates" are sometimes carried out, for which a reserves evaluation report is run after the "as-of" date, with a different price forecast, but all other data unchanged. When these are used for public reporting, disclosure should make it very clear that this is the case, and if material changes other than prices also have occurred, a new evaluation may be appropriate, and may be required.

i. Reserves Risk Disclosure and Disclaimers

Sections on risk factors in prospectuses often contain sweeping and unqualified disclaimers on the validity of reserves estimates, typically to the effect that they may be materially different. A statement that a reserves evaluation is an estimate and is not precise is appropriate, but should be consistent with the fundamental basis that reserves are classified by the degree of uncertainty.

In particular, risk disclosure should recognise that the likelihood that actual production will be less than reported proved reserves, should be negligible for an issuer with more than a few properties.

Staff may request rewording of unqualified disclaimers that essentially negate the fact that reserves are classified according to uncertainty of recovery.

j. Terminology and Notation

The misuse of notation is pervasive, and in particular, attention should be paid to correct use of metric and Imperial system prefixes and symbols. For instance, in the Imperial system, the correct terminology for thousand cubic feet is Mcf, not mcf. Reference should be made to Appendix C of COGEH for correct usage.

2. A REVIEW OF TECHNICAL REVISIONS IN FORM 51-101F1 FILINGS

a. Introduction

Technical revisions are changes in reserves in properties contained in the opening balance that are still owned at the end of the reconciliation period. They occur as the result of new technical information, including production information. Although technical revisions are intended to be "pure" revisions to volumes in the opening balance, due to a misunderstanding of the requirements in this first year for NI 51-101, some filers included infill drilling and technical revisions to acquisitions made during the year. The data discussed here contain some adjustment for these items.

Staff has carried out an analysis of the technical revisions, although some issuers have been excluded from the analysis:

- ▶ Fourteen issuers that have exemptions permitting them to report using SEC/FASB requirements. The "Changes in the Net Quantities of an Enterprise's Proved Reserves of Oil and Gas During the Year" of the SEC/FASB system is not a "pure" technical revision, since it contains other factors, such as infill drilling, and cannot be used for the type of analysis carried out here.
- ▶ A small number of issuers have also been excluded because of unresolved questions in their reserves numbers. Their omission has no significant effect on the general results.
- ▶ Twenty-three per cent of the issuers in the analysis had no reserves at January 1, 2002, and hence, no Technical Revisions.

- ▶ Not all issuers had reserves for all production types.

Table 1 summarises the technical revision in reserves for light and medium oil, heavy oil, and associated and non-associated gas. Bitumen and synthetic oil have not been included because of insufficient data, and natural gas liquids have not been included, since they are a by-product of oil and gas production. None of the issuers in the analysis reported coal bed methane reserves.

	L & M Oil		Heavy Oil		Associated and Non-Associated Gas	
	1P MMbbl	2P MMbbl	1P MMbbl	2P MMbbl	1P Bcf	2P Bcf
Number of companies	138	138	44	44	155	155
RESERVES 31 DEC 2002	793.5	969.8	220.8	270.6	6392.6	7953.3
Total Technical revisions						
Volume	(41.8)	(3.7)	(43.6)	(40.4)	(571.4)	(338.7)
% Revision	(5.3)	(0.4)	(19.7)	(14.9)	(8.9)	(4.3)
Average per company	(0.3)	(0.0)	(1.0)	(0.9)	(3.7)	(2.2)
Positive Technical revisions						
Volume	14.7	32.7	4.3	9.1	59.4	150.2
Number of Positive revisions	55	66	16	17	47	59
Average positive revision	0.3	0.5	0.3	0.5	1.3	2.5
Negative Technical revisions						
Volume	(56.4)	(36.4)	(47.9)	(49.5)	(630.8)	(488.9)
Number of negative revisions	75	67	25	24	103	93
Average negative revision	(0.8)	(0.5)	(1.9)	(2.1)	(6.1)	(5.3)
Number of zero revisions	8	5	3	3	5	3

Table 1. Average Technical Revisions by Production Type

b. The Analysis of Technical Revisions

Figures 1 to 6 show histograms of percentage technical revisions in reserves for different production types and reserves classes, but a simple histogram provides only a partial picture. A greater insight can be attained from considering that the data consist of the reported reserves for an issuer, that is, the sum of the reserves for all of an issuer's properties.

Reported proved reserves must satisfy the criterion that there is *"at least a 90% probability that the actual quantities recovered will equal or exceed the estimated proved reserves"*.

Reported proved + probable reserves must satisfy the criterion that there is *"at least a 50% probability that the quantities recovered will equal or exceed the sum of the estimated proved plus probable reserves"*.

The technical revisions reported in Form 51-101F1 are aggregate values (i.e. reported reserves) for all the properties reported by a particular issuer. Although the data are not available by property, it is a reasonable assumption that the greater the reserves volume, the more properties there are. It is a fundamental feature of such data that as the number of properties increases, the ups and downs of the technical revisions will tend to compensate for each other.¹ A plot of the technical revisions as a percentage of the opening reserves versus opening reserves would, therefore, be expected to show that the greater the opening reserves, the less the percentage change.

The above points provide a series of tests for the quality of reserves evaluation:

Reported proved reserves

- ▶ There should be many more positive than negative technical revisions.
- ▶ The average revision should be positive.
- ▶ The magnitude of technical revisions should decrease as the number of properties (or volume) of reserves increases.

Reported proved + probable reserves

- ▶ The number of positive and negative technical revisions should be about the same.
- ▶ The average technical revision to proved + probable reserves should be close to zero.
- ▶ The magnitude of technical revisions should decrease as the number of properties (or volume of reserves) increases. For issuers with more than a small number of properties, technical revisions should be negligible.

Figures 7 to 12 show the technical revisions as a percentage of the opening balance reserves plotted against the opening balance reserves for different reserves classes and production types.

c. Results of Analysis of Technical Revisions

For proved reserves, the proportion of positive revisions, which should be at least 90% and increase as the number of properties increases, is much lower than expected, and the average technical revision should be positive. The magnitude of the average revision for gas seems to be particularly high.

For proved + probable reserves, for light and medium oil, the proportion of positive revisions and the average revision are close to the expected values. For heavy oil and gas the proportion of positive revisions is low, although the magnitude of the average revision for heavy oil is within reasonable limits.

All the plots of technical revisions as a percentage of opening reserves versus opening reserves conform to what would be expected from statistical theory. Issuers that are outliers on these plots have been selected for review. The anomalous points showing negative technical revisions of greater than 100% are probably the result of revisions to acquisitions made during the year, and will also be investigated.

¹Although a detailed discussion is beyond the scope of this report, this is a consequence of the Law of Large Numbers, which is an aspect of the fundamental Central Limit Theory of statistics. Details can be found in statistical texts.

Although the general pattern conforms to expectations, the magnitude and spread of revisions for those issuers with small reserves volumes suggests that more care is needed in estimating entity level reserves.

It should be noted that this discussion is concerned with the analysis of technical revisions over a period of one year. The analysis of data from a period of more than one year involves additional factors and is more complex than suggested here.

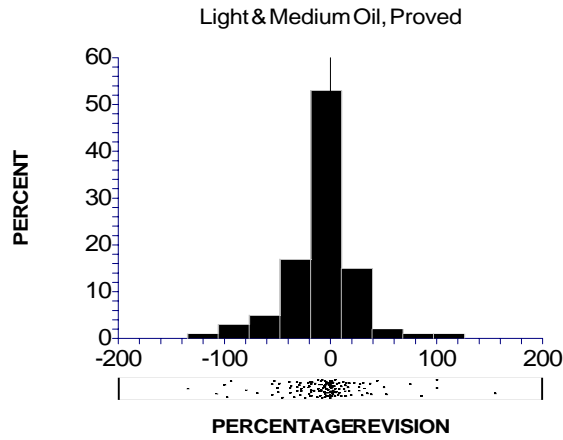


Figure 1. Light and Medium Oil, Percent Technical Revisions in Opening Proved Reserves

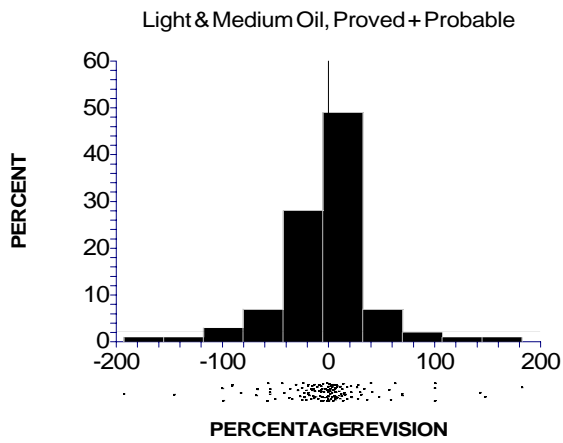


Figure 2. Light and Medium Oil, Percent Technical Revisions in Opening Proved + Probable Reserves

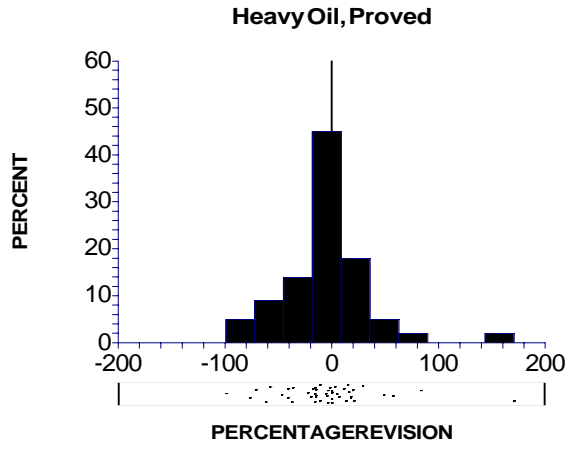


Figure 3. Heavy Oil, Percent Technical Revisions in Opening Proved Reserves

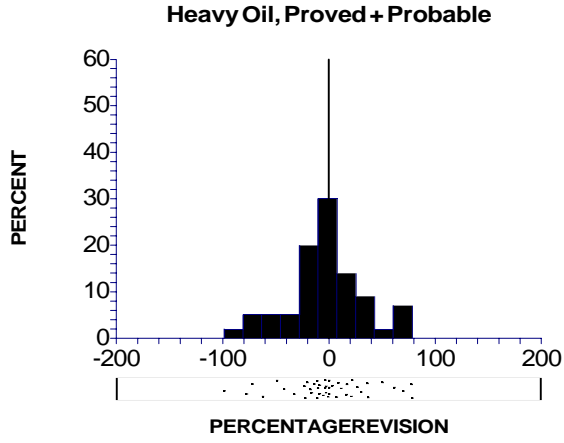


Figure 4. Heavy Oil, Percent Technical Revisions in Opening Proved + Probable Reserves

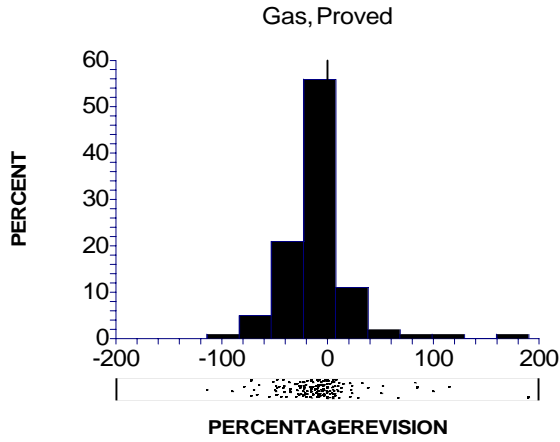


Figure 5. Histogram. Percent Revisions in Natural Gas Proved Reserves

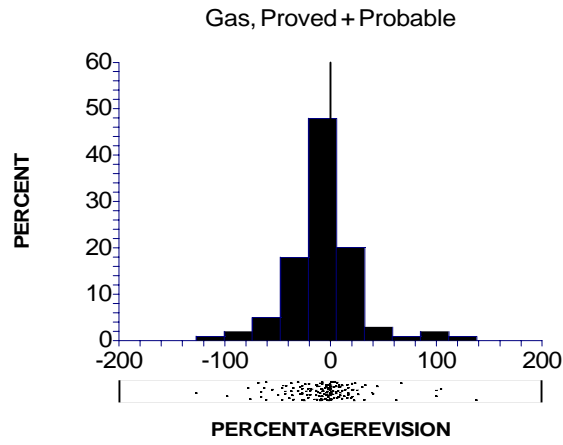


Figure 6. Histogram. Percent Revisions in Natural Gas Proved + Probable Reserves

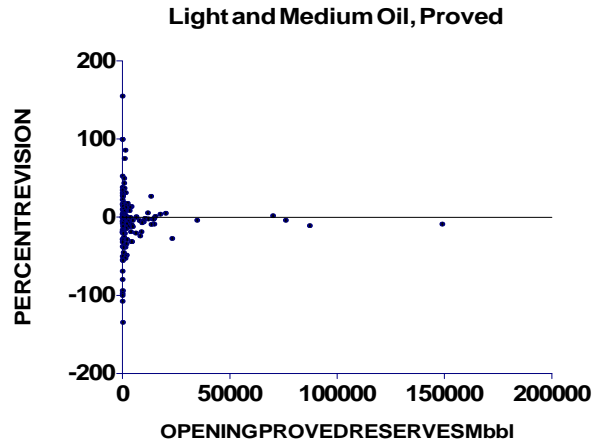


Figure 7. Light and Medium Oil, Proved Reserves Technical Revisions vs. Reported Opening Proved Reserves

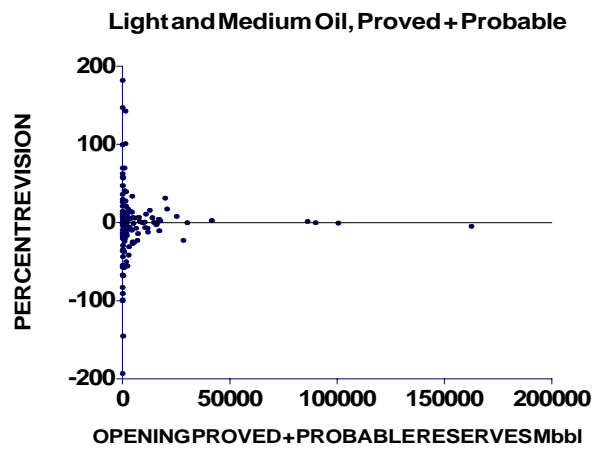


Figure 8. Light and Medium Oil, Proved + Probable Reserves Technical Revisions vs. Reported Opening Proved + Probable Reserves

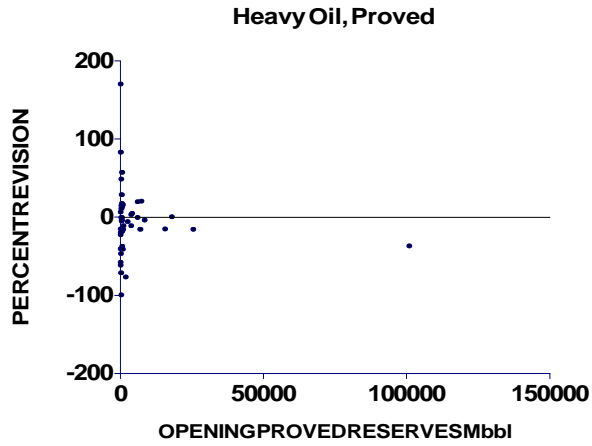


Figure 9. Heavy Oil, Proved Reserves Technical Revisions vs. Opening Proved Reserves

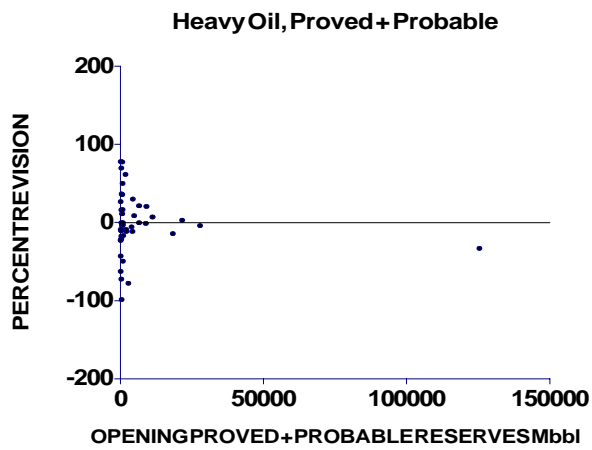


Figure 10. Heavy Oil, Proved + Probable Reserves Technical Revisions vs. Reported Opening Proved + Probable Reserves

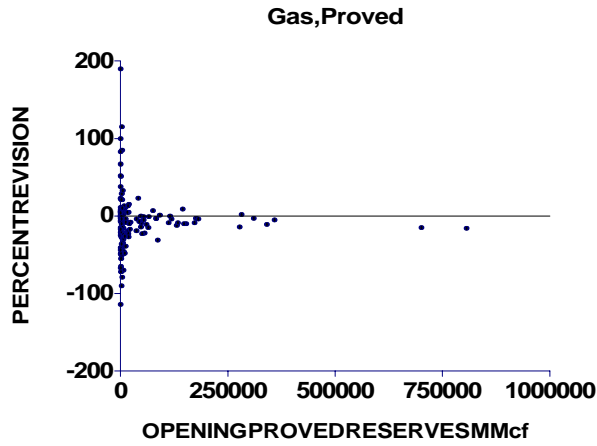


Figure 11. Gas, Proved Reserves Technical Revisions vs. Reported Opening Proved Reserves

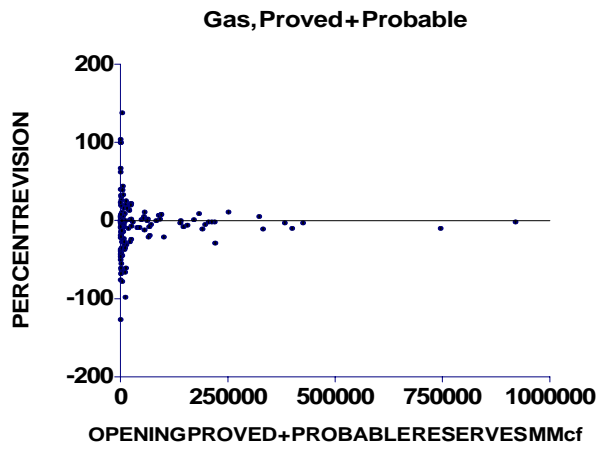


Figure 12. Gas Proved + Probable Reserves Technical Revisions vs. Reported Opening Proved + Probable Reserves