*PUBLIC VERSION*

**IN THE MATTER OF AN ARBITRATION UNDER CHAPTER ELEVEN OF THE NORTH AMERICAN FREE TRADE AGREEMENT AND THE 1976 UNCITRAL ARBITRATION RULES**

**BETWEEN:**

**THEODORE DAVID EINARSSON, HAROLD PAUL EINARSSON, RUSSELL JOHN EINARSSON, GEOPHYSICAL SERVICE INCORPORATED (GSI)**

**(the "Claimants")**

**AND**

**GOVERNMENT OF CANADA**

**(the "Respondent", and together with the Claimants, the "Disputing Parties")**

**(ICSID Case No. UNCT/20/6)**

---

# EXPERT REPORT OF ROBERT HOBBS

**January 14, 2023**

---

**I. BACKGROUND AND QUALIFICATIONS ..... 2**
**II. PURPOSE OF THIS REPORT ..... 4**
**III. OVERVIEW OF THE MARINE SEISMIC INDUSTRY ..... 5**
A. Marine Seismic Industry Players and Trends ..... 5
B. Consolidation in the Marine Seismic Industry ..... 10
C. Seismic Market Trends Since 2000 ..... 11
D. Seismic Technology ..... 19
E. Seismic Commercial Models ..... 22
F. Conclusions on the Marine Multi-Client Seismic Industry ..... 36
**IV. OBSERVATIONS ON PWC (SHARP) REPORT AND VALUATION OF GSI ..... 37**
A. PWC Report Assumptions ..... 37
B. Impact of Competition and Location on Multi-Client Seismic Data Valuation ..... 41
C. Conclusions on PWC Report and Valuation of GSI ..... 43
**V. CURRICULUM VITAE ..... 45**

## I. BACKGROUND AND QUALIFICATIONS

1. I, Robert Hobbs of Houston, Texas and citizen of the United States of America, have more than 33 years of working in the seismic industry and oil and gas exploration fields. I hold a Bachelor of Science Degree in Geology from Baylor University and a Master of Science Degree in Geoscience from The University of Southern California.

2. I spent approximately 10 years as an explorationist and geoscience manager with oil and gas exploration companies Exxon, Union Texas Petroleum and Marathon. In these positions, my primary role was to utilize seismic data, including non-exclusive/multi-client ("MC") seismic data,[1] to generate exploration prospects for the drilling of oil and gas wells. To accomplish this, in many cases my role was to view available MC data and recommend the purchase of data licenses for the use of this data.

3. Eighteen years of the latter part of my career has been spent in executive positions with the geophysical data and service companies Veritas DGC and TGS Nopec ASA ("TGS"). Specific to the MC (non-exclusive) seismic data industry, I developed offshore MC projects for Veritas from 1998 to 2004 including MC depth imaging projects in the deepwater US Gulf of Mexico, and in the Santos and Campos Basins of Brazil. From 2004-2007, I served as President of Europe, Africa, and Middle-East for Veritas where I supervised and approved offshore MC investments and led Veritas' contract business in those regions.

4. From 2008-2016, I served as Chief Operating Officer ("COO") and then Chief Executive Officer ("CEO") of TGS, the largest global publically-traded MC seismic data company. TGS has been the largest investor and revenue generator in the MC industry for many years. The company was formed in 1981 and was listed on the Oslo Stock Exchange

[1] The terms "multi-client", "non-exclusive" and "speculative" seismic data are terms used interchangeably in the industry to describe seismic data that is shot by a company to license to multiple customers. This is in contrast with "exclusive" seismic data, which a company will undertake on contract on behalf of a specific customer(s) and does not retain for further licensing (i.e., the customer retains ownership of the seismic data).

in 1997. For my entire career at TGS, I was based in Houston, Texas at its operational headquarters. I retired as CEO of TGS in 2016.

5. While I was COO/CEO of TGS, I was made aware of the existence of a litigation initiated by Geophysical Service Incorporated ("GSI") in 2014 against TGS in the United States regarding GSI's seismic data. I had no involvement in that litigation, which was handled by TGS's legal department and external counsel. From TGS's perspective this was not a significant matter. As CEO, I was not informed of details regarding the litigation, only that there was a process ongoing. I do not recall being informed by the legal department of the outcome of the litigation during my tenure at TGS, and I have had no involvement in the matter since I retired in 2016. Other than being aware of the existence of GSI's litigation against TGS, I have no other connection to GSI, Mr. Davey Einarsson, Mr. Paul Einarsson or Mr. Russell Einarsson.

6. For the past 6 years, I have been an independent consultant in the seismic industry with my own firm Live Oak Exploration. I also currently serve (since November of 2019) as an independent Director and Chairman of the Board for Shearwater Geoservices ("Shearwater"), the world's largest offshore marine geophysical contractor. Shearwater is a privately owned offshore geophysical contractor based in Bergen, Norway and founded in 2016. It has the largest fleet of seismic vessels in the industry. It conducts exclusive seismic surveys for oil and gas companies and operates as a contractor to MC seismic companies on a project-by-project basis. Shearwater does not invest in MC surveys and does not license its own seismic data.

7. From 2013-2014, I served as Chairman of the International Association of Geophysical Contractors ("IAGC"), which is now called EnergeoAlliance. EnergeoAlliance is the global trade association for the offshore seismic industry. As part of its function, EnergeoAlliance works with its members to help develop common trade rules and practices for the MC industry. This includes regularly reviewing and publishing a model Master Data Licensing Agreement for the industry as well as advocating to governments and the public towards assuring a healthy MC industry. I note that, according

to the expert report of Chip Gill, GSI was a member of the IAGC until 2009 or 2010,[2] which was before I served as Chair of IAGC.

8. Part V of this Report contains a copy of my curriculum vitae.

## II. PURPOSE OF THIS REPORT

9. I have been retained by the Government of Canada as an independent expert in this arbitration to opine on matters related to the global offshore seismic industry, including my experience with investments in MC seismic surveys, submission and public disclosures of seismic data by government regulators and industry standards for the valuation of MC seismic data companies. I have no other relationship with the disputing parties in this matter.

10. In preparation of this Report, I have reviewed the Claimants' Memorial, Witness Statements and Expert Reports submitted on September 27, 2022. In addition, I have referred to publically available information on industry trends, including seismic equity analysts reports. I have also reviewed maps and other information published on GSI's website and those supplied by the Canada-Newfoundland and Labrador Offshore Petroleum Board ("CNLOPB"), the Canada-Nova Scotia Offshore Petroleum Board ("CNSOPB") and the Canada Energy Regulator ("CER", formerly known as the National Energy Board or "NEB") which show seismic data coverage in the regions under their jurisdiction. Otherwise, this Report is based on professional experience gained throughout my career.

11. Part III of this Report provides an overview of the offshore MC seismic industry. Sections A-C begin with an overview of the marine seismic industry, including a description of the market players and recent MC seismic data industry trends towards consolidation since the 2000s, as a result of offshore oil and gas exploration and production ("E&P") capital spending trends and the oversupply of offshore seismic vessels. In

[2] **CER-03**, Expert Report of Chip Gill, ¶ 13.

Section D, I discuss key aspects in regards to seismic technology, differentiating between onshore and offshore data acquisition. In Section E, I describe the 2 primary business models that the offshore seismic industry uses to commercialize seismic data: (1) Contract Sales ("exclusive"); and (2) Multi-client (MC or "non-exclusive") Sales. In the case of the MC (non-exclusive) Sales Model, this Report explains the licensing process, MC revenue streams, factors influencing decisions to invest in new data library products and the MC Project Evaluation Model, which is used to model financial decisions for investment in MC seismic surveys.

12. Part IV of this Report, provides observations on the approach taken by the Claimants' expert, Mr. Paul Sharp at PricewaterhouseCoopers ("PWC") to valuing GSI. As explained, in Section A, Mr. Sharp's valuation approach fails to account for many relevant market trends and the requirement to make continued investment in GSI's seismic data library, and significantly overestimates GSI's estimates of "assumed revenues" in the MC seismic industry. Lastly, in Section B, I describe how the impacts of competition, permit expiration and seismic data location could impact the value of GSI's seismic data.

## III. OVERVIEW OF THE MARINE SEISMIC INDUSTRY

### A. Marine Seismic Industry Players and Trends

13. The modern era of the seismic industry started in the 1980s after computation started to change the way companies collected, processed and used seismic data. Since the 1990s, the industry has gone through significant changes through periods of growth and consolidation before evolving into the current structure that we see today, which, as I describe below, has become global due to the mobile nature of seismic platforms (marine vessels) and due to MC data portfolio diversification.

14. Initially, the industry was dominated by two companies, the French company CGG and the American company Geophysical Service Inc., which was the original GSI ("OGSI") most recently owned by Texas Instruments and then Halliburton until 1992 (not to be confused with the "new" GSI, a company with a similar name formed by Mr. Davey

Einarsson in 1993). Both CGG and OGSI got their start in the 1930s by using analog refraction and reflection seismology to explore the subsurface for oil and gas and mineral resources. However, since the 1990s, other companies have come to dominate the global seismic market and have been heavily involved in Canadian offshore seismic acquisition during this time.

### 1. Market Players

#### (a) CGG

15. CGG was founded in the early 1930s by Conrad Schlumberger and Marcel Champin in France.[3] Throughout its history, CGG has been one of the larger consolidators in the seismic industry, acquiring many smaller specialized seismic companies. In 2007, CGG combined with Veritas DGC (of which I was President-Europe, Africa, Middle East at the time) to create one of the largest full-service geophysical companies and the most advanced processing company in the world. In 2013, CGG acquired Fugro's geoscience division comprising their fleet of seismic vessels. In 2020, CGG exited the onshore seismic data acquisition business and exited the marine seismic acquisition business through the sale of its vessels to Shearwater. CGG is now only in the business of seismic processing, MC data licensing and equipment manufacturing and sales.

#### (b) SLB/WesternGeco

16. A division of the oil service giant Schlumberger, WesternGeco was recently rebranded as SLB.[4] The company originated with the rebranding of OGSI into Texas Instruments ("TI") in 1951, and the sale of OGSI to Halliburton in 1988 when it was renamed Halliburton Geophysical Services ("HGS"). In 1994, HGS was sold by Halliburton to Western Atlas. Western Atlas was bought by Baker Hughes in 1998 and was merged into WesternGeco in 2000 through a joint venture with Schlumberger. WesternGeco was a dominant player in the global seismic market from 2000-2018,

[3] **R-160**, CGG, Website Screenshot, as of 6 January 2023, available at: CGG: This is CGG

[4] **R-161**, Schlumberger, Website Screenshot, as of 6 January 2023, available at: Our History | SLB

including in Canada, as a full service geophysical company having acquisition, processing and MC businesses. In 2018, WesternGeco sold its marine geophysical acquisition business (including all vessels) to Shearwater. SLB continues to maintain the seismic processing and MC businesses under the WesternGeco brand.

17. According to Davey Einarsson, a former Halliburton employee, the "new" GSI – the Claimant enterprise in this arbitration – was born when on or about 1993, a transaction occurred which transferred ownership of the Canadian seismic data library from Halliburton to a private company called Geophysical Speculative. Geophysical Speculative was controlled by Davey Einarsson and transferred the Canadian seismic data to the new GSI.[5]

### (c) **PGS**

18. PGS was formed through the merger of Geoteam and Precision Seismic in 1991.[6] It was listed on the Oslo Stock Exchange in 1992 where it remains today. Throughout its history, PGS has remained an integrated marine seismic company with acquisition, processing and MC divisions. After consolidation involving other companies in the seismic industry, PGS remains as the only "fully integrated" seismic company that conducts marine acquisition, seismic processing and MC project development and sales.

19. PGS has partnered since 2011 with TGS on several MC campaigns off the east coast of Canada. This partnership, which commenced with the acquisition of several vintages of 2D seismic data, has continued with several vintages of 3D seismic data. A total of 13 3D seismic surveys have been acquired as part of the partnership with TGS. PGS has acquired 3 seismic surveys, all in 2021, outside of the partnership with TGS. PGS's proprietary GeoStreamer multi-sensor streamer was seen as a compelling technology to image the

[5] **CWS-03**, Davey Einarsson Witness Statement, ¶¶ 16-17.

[6] **R-162**, PGS, Website Screenshot, as of 6 January 2023, available at: Our 30 Year History | PGS

complex geology off of the east coast of Canada and PGS's ownership of this technology was critical for the partnership and permitting required for the success of these projects.

#### (d) TGS

20. TGS was formed in 1981 by David Worthington as a private company and focused on the MC business in the US Gulf of Mexico basin. It merged with an Oslo-listed company called NOPEC on or about 1998 and adopted NOPEC's public listing. It is often thought of as the company that was primarily responsible for the inception of the MC seismic business model. It has largely maintained this "asset-light" MC data position to this day (i.e., contracting other ships to conduct seismic surveys). TGS has also been the largest consistent investor in the MC business.

21. TGS acquired Spectrum ASA in May of 2019. This transaction added over 3.35 million km of 2D seismic data and over 200,000 $km^2$ of 3D seismic data to TGS's library including a significant amount of data that Spectrum had acquired from Fugro in 2015.[7]

22. As stated earlier, TGS has had a multi-year partnership with PGS to acquire and market both 2D and 3D seismic data off of the east coast of Canada.

### 2. Other Market Players

#### (a) Multi-Client

23. There are several smaller MC companies that focus on particular regions around the world. These include Searcher, which markets reprocessed data from public databanks from around the world. In Nova Scotia, Searcher has reprocessed and markets 2D and 3D seismic data in the Sable Island area.[8]

[7] **R-163**, Spectrum ASA, 2018 Annual Report, pp. 8, 17, 27.

[8] **R-164**, Searcher Seismic, Data Library – Canada, Website Screenshot, as of 6 January 2023, available at: Data Library » Searcher (searcherseismic.com)

24. Geoex MCG is another MC company providing seismic data around the world. It is a private company based in the United Kingdom. Geoex MCG does not own or market data offshore Canada.[9]

25. GeoPartners Ltd ("GeoPartner") is a privately-owned small multi-client company and consultancy. All of GeoPartner's MC projects are located in northwest Europe and Africa.[10]

26. As seismic data is made publicly available by government regulators, oil companies are free to access the available information directly through the government sources or through data brokers that specialize in marketing the public information.

### (b) Marine Data Acquisition Companies

27. PXGEO is a private company specializing in offshore data acquisition. The company operates two 3D streamer vessels and two ocean bottom node crews.[11]

28. Seabird Exploration is an Oslo-listed company specializing in offshore data acquisition. The company owns and operate two seismic vessels (one of which is 3D capable).[12]

29. There are two Chinese state-owned geophysical companies (COSL and BGP). Both of these companies primarily operate for Chinese E&P operators. BGP has acquired some

[9] **R-165**, Geoex MCG, Website Screenshot, as of 6 January 2023, available at: https://www.geoexmcg.com/

[10] **R-166**, GeoPartners Ltd, Website Screenshot, as of 6 January 2023, available at: https://www.geopartnersltd.com/projects

[11] **R-167**, PXGEO, Website Screenshots, as of 6 January 2023, available at: Towed Streamer | PXGEO and Ocean Bottom Nodes | PXGEO

[12] **R-168**, Seabed Exploration, Website Screenshot, as of 6 January 2023, available at: Fleet | SeaBird Exploration (sbexp.com)

data for TGS and Spectrum in past years. BGP also owns a limited amount of MC seismic data (primarily 2D) around the world. None of this data is located in North America.[13]

30. There are three Russian offshore seismic data acquisition companies (MAGE, SMNG, DMNG). These three small companies primarily provide services in Russian waters.

### B. Consolidation in the Marine Seismic Industry

31. Since the purchase of the seismic fleets of WesternGeco and CGG by Shearwater, the industry has consolidated to 5 major players, two of which are vessel owners/operators (Shearwater and PGS) and three of which are pure MC companies (see Figure 1, below).

Figure 1: Diagram illustrating the evolution of the global seismic industry throughout the 2000's.[14]

[13] **R-169**, BGP Inc., Multi-client library, Website Screenshot, as of 6 January 2023, available at: http://www.bgp.com.cn/bgpen/Multiclientlibrary/first_common.shtml

[14] Source: John Olaisen, ABG Sundal Collier.

### C. Seismic Market Trends Since 2000

32. Revenues in the seismic industry are generally correlative to offshore E&P capital spending trends. In an active offshore exploration cycle, there is more interest in accessing seismic data.

33. As seen in Figure 2, offshore E&P spending increased substantially in the mid-2000's and peaked in 2014. Spending on offshore seismic data generally followed that trend, but with the notable exception of 2009 and 2010, where there was a significant drop caused by the 2008 financial crisis that caused E&P exploration companies to substantially cut their spending on seismic exploration (particularly in North America). Annual reports at the time reflect this, for example:

1) "WesternGeco revenue in 2009, at $2.12 billion, was 25% lower than 2008. Revenue fell across all product lines, with the largest declines seen in Marine and Multi-client. Marine revenue fell on lower activity and reduced pricing as a result of weaker market conditions while Multi-client revenue decreased as customers reduced discretionary spending – primarily in North America."[15] WesternGeco's 2010 annual report noted again that the largest declines in revenues were experienced in marine and multi-client: "multi-client revenue decreased primarily in North America, as customers continued to reduce discretionary spending."[16]
2) In 2009, TGS's multi-client 2D seismic revenues decreased by 17% and multi-client 3D seismic revenues decreased 14% from 2008.[17] In TGS's 2009 annual report, the company stated, "Our customers halted all discretionary spending until they could gain more visibility on the economy and on oil and gas demand. E&P spending budgets were reduced, reconsidered and in some cases reduced again".[18]
3) In 2009, PGS's contract marine seismic revenues declined 16% from 2008 and MC revenues declined 20%. PGS stated, "Financial performance in our Marine

[15] **R-170**, Schlumberger Limited, 2009 Annual Report, p. 2. The 2009 Annual Report also noted "weaker marine activity and pricing and reduced Multiclient sales in WesternGeco" contributing to decline in gross margins. *See* p. 23.

[16] **R-171**, Schlumberger Limited, 2010 Annual Report, "WesternGeco", p. 24.

[17] **R-172**, TGS, 2009 Annual Report, p. 8.

[18] **R-172**, TGS, 2009 Annual Report, p. 4.

> segment declined in 2009 compared to last year. Reduced demand and global vessel oversupply were the main reasons for lower revenues and margins".[19]

34. Spending on seismic data exploration began to rebound in 2011 as the global economy emerged from the 2008 financial crisis and then hit its peak in 2013.

Figure 2: Graph showing offshore E&P spending and seismic spending in USD billions from 1991 through 2021.[20]

35. The global seismic industry responded to this increase in demand by growing the number of seismic vessels operating in the market from 49 in 2000 to a high of about 60 in 2013 (Figure 3). These vessels were primarily operated by the 3 vessel owners/operators at the time (PGS, WesternGeco, CGG).

[19] **R-173**, PGS, 2009 Annual Report, p. 10.

[20] Source: John Olaisen, ABG Sundal Collier.

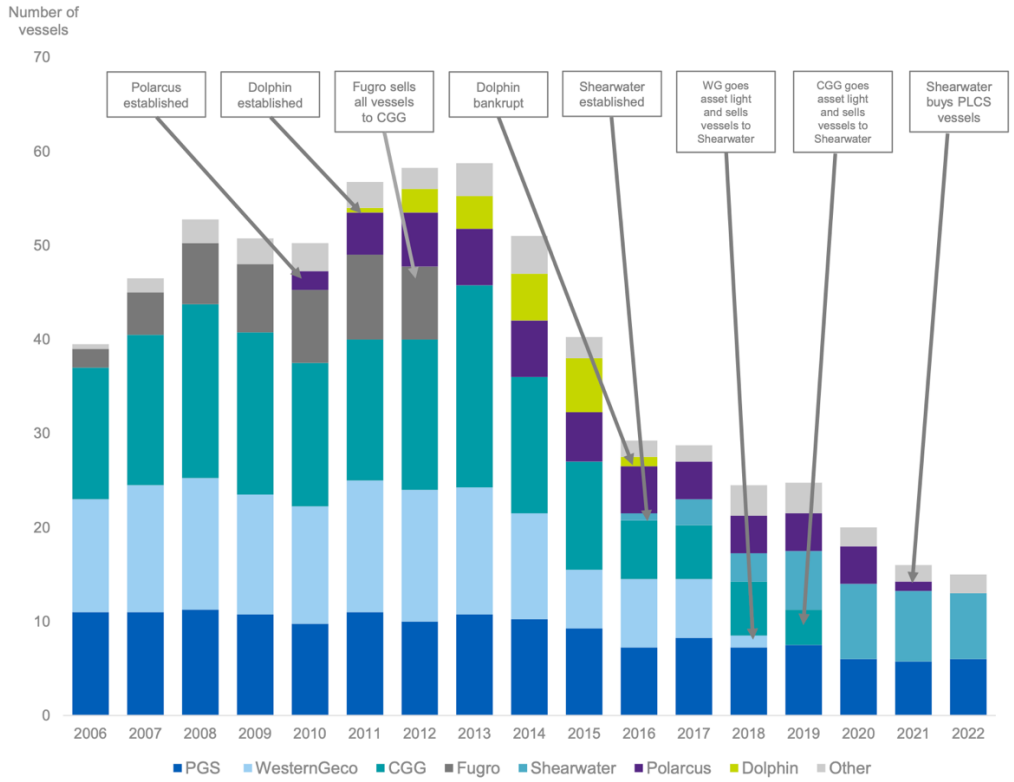



Figure 3: Graph showing the number of active marine seismic vessels in the international seismic industry.[21]

36. After strong years between 2011 and 2013, offshore seismic demand collapsed again after 2014 as production from onshore shale hydrocarbon plays in North America accelerated and diverted investment away from offshore exploration.[22] Following this sharp increase in proven reserves in North American unconventional (i.e., shale) reservoirs, the Organization of the Petroleum Exporting Countries ("OPEC") increased production steeply into 2017 to try and regain market share (Figure 4). This attempt at controlling market share collapsed global oil pricing and was not only effective in causing the market

[21] **R-174**, PGS, Third Quarter 2022 Presentation, 26 October 2022, p. 21.

[22] The increase in onshore shale play activity in North America did not result in substantial benefit to the seismic industry as success in shale plays is more dependant on identifying rock that is of sufficient carbon content and brittleness that hydrocarbons can be produced through hydraulic fracturing rather than finding specific hydrocarbon traps through seismic surveys. In any event, to my knowledge, GSI did not have significant onshore data assets within regions that are of interest to oil companies that produce from unconventional or tight formations.

for North American onshore drilling to collapse, but reinforced the decrease in offshore E&P spending as well as offshore seismic spending. Figure 2 shows that spending on offshore seismic 2016-2018 dropped to levels not seen since the early 2000s. While there was an uptick in 2019, the COVID-19 pandemic from 2020-2021 resulted in spending on offshore seismic to drop to its lowest level since 1995. How far the industry will recover remains to be seen.

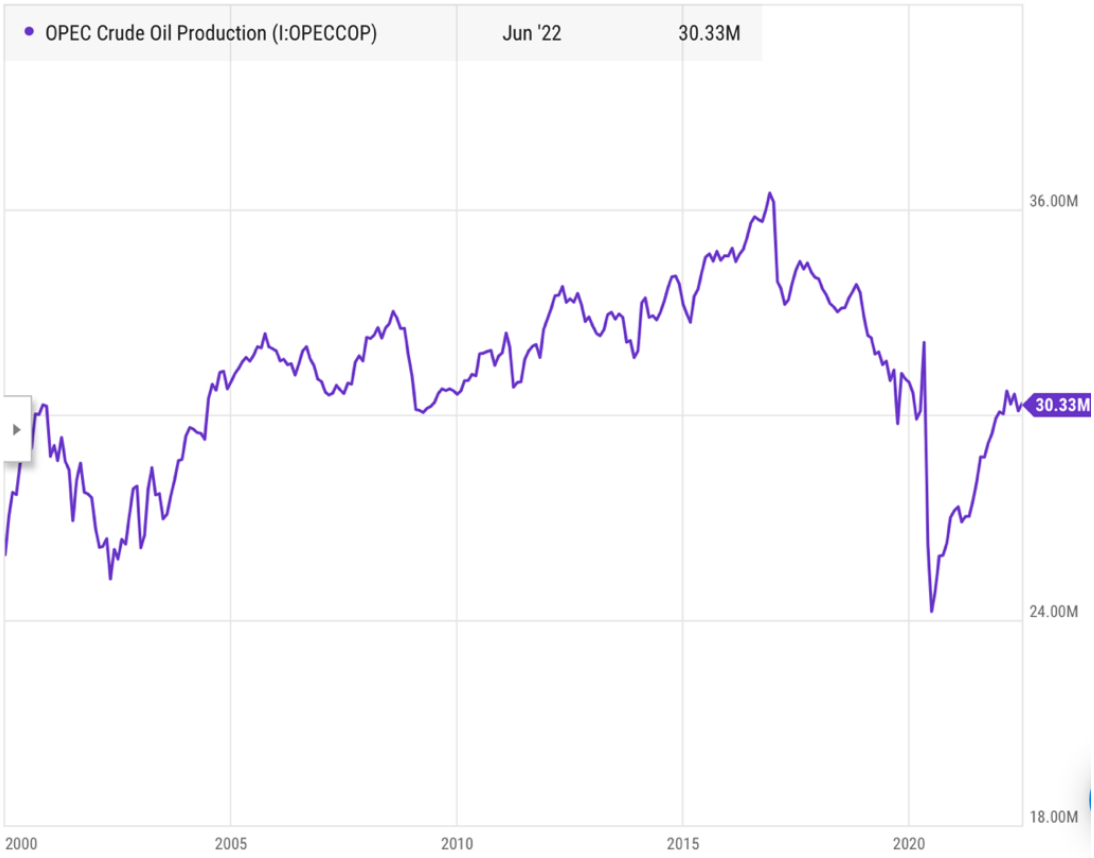



Figure 4: OPEC crude oil production in million barrels per month. Note the significant increase in production from 2013 through 2017 to compete against growing onshore North American production.[23]

37. As a result of the collapse in offshore seismic spending in 2014, the steep growth in the global seismic fleet seen between 2000 and 2013 was unsustainable. The offshore seismic market became oversupplied and day rate prices for seismic vessels collapsed.

[23] **R-175**, OPEC, Crude Oil Production, Source Information Chart, as at 31 August 2022.

Many vessels built during this period found themselves without work and the significant costs to maintain the vessels and service the debt supporting the vessels drove several companies to divest of their ships or declare bankruptcy (Figure 3).

38. Fugro divested of their vessels in 2012, Dolphin declared bankruptcy in 2016, CGG reorganized through a managed bankruptcy in 2017, WesternGeco divested of their vessels to Shearwater in 2018, CGG sold their vessels in 2019, and Polarcus declared bankruptcy in 2020.

39. The barriers to entry into the offshore seismic market are now quite high given the difficulty in obtaining financing for new vessels and equipment. The financial markets are not likely to support an increase in capacity in the foreseeable future given the continued oversupply of vessels in the market (there are only approximately 15 vessels active out of a total global fleet of approximately 34 vessels).

40. As shown in Figure 1, consolidation in the industry started in 2011 and accelerated in 2016 due to the sharp reduction in seismic activity caused by the 2008 financial crisis and then the shift to onshore shale plays.

41. What has now resulted from the consolidation of the industry is a differentiation between asset operating companies and the asset-light, pure-play MC companies:

Major Asset Operating Companies
- Shearwater: 23 Seismic Vessels (9 active), Full Processing Services
- PGS: 11 Seismic Vessels (6 active), Processing for MC, MC Data Library

Major Asset-Light MC Companies
- TGS: MC Library, Processing for MC
- CGG: MC Library, Full Processing Services, Equipment Manufacturing
- SLB/WesternGeco: MC Library, Full Processing Services

42. The primary business of the asset operating companies is to conduct seismic surveys on a contract basis for customers. Those customers can be E&P companies, MC companies, governments or research organizations. Payment for the collection of the data is typically through a day rate mechanism where the customer pays for the vessel during the duration

of the project. The cost of the vessels that these players operate can be significant, with a new-build 3D seismic vessel reaching around USD 250 million in cost. To equip the 3D vessel with source and streamer gear can reach an additional investment of approximately USD 50 million.

43. The asset-light MC companies invest in the collection of seismic data, process that data and market that data on a non-exclusive basis. Like E&P companies, the MC companies do not own or operate the means to collect the data (i.e., onshore crews or offshore vessels). These companies charter, or rent, the capacity to collect the data from the asset operating companies.

44. Compared to companies that currently operate in the MC marine seismic data industry, GSI would also be a very small player from a global perspective (GSI's website indicates that it carried out seismic surveys abroad in the 2000s, including Argentina, Falkland/Malvinas, the Mediterranean and Morocco).[24] GSI is less than 5% of the size of TGS in terms of library size. The following table compares the relative current sizes of MC data libraries between GSI and the other MC companies.

[24] **R-158**, Geophysical Service Incorporated, International Maps website screenshot, as of 6 January 2023, available at: http://www.geophysicalservice.com/index.php?mode=webpage&id=622

### 1. Comparison of GSI's Global Seismic Data Library Inventory to Other Major Industry Players

| Company | 2D (km) | 3D (sq km) | Other |
|---|---|---|---|
| GSI[25] | 300,000 | 4,800 | |
| TGS[26] | 5,512,611 | 1,104,138 | 9,473,902 well logs |
| PGS[27] | 590,000 | 1,100,000 | 875,000 MegaSurvey Data |
| CGG[28] | 0 | 1,210,000 | |
| WesternGeco[29] | 3,000,000 | 3,000,000 | |

### 2. Canada MC Activity

45. In Canada, PGS has acquired substantial 2D and 3D MC seismic data in offshore Newfoundland and Labrador since 2011, where it currently markets 180,000 km of 2D MC seismic data and over 86,000 km$^2$ of 3D MC seismic data.[30] TGS has been active in offshore Eastern Canada since 1998 and has approximately 270,000 km of 2D MC seismic data and 33,500 km$^2$ of 3D MC seismic data in the offshore areas of Newfoundland and Labrador (including the North Labrador Sea and into the Davis Strait) and Nova Scotia.[31] WesternGeco also has substantial 2D and 3D surveys in Nova Scotia as well as offshore Newfoundland and Labrador.

---

[25] **R-176**, Geophysical Service Incorporated, Non-exclusive Data, website screenshot, as of 6 January 2023, available at: http://www.geophysicalservice.com/index.php?mode=webpage&id=584

[26] **R-177**, TGS, 2021 Annual Report, p. 25.

[27] **R-178**, PGS, 2021 Annual Report, pp. 22-23.

[28] **R-179**, CGG, 2021 Annual Report, p. 27.

[29] **R-180**, Schlumberger Limited, Multiclient Data Library, Website Screenshot, as of 6 January 2023, available at: https://www.slb.com/reservoir-characterization/seismic/multiclient-data-library

[30] *See* **R-181**, PGS, Data Library Hotspots, "Newfoundland and Labrador", Website Screenshot as of 6 January 2023, available at: https://www.www.pgs.com/data-library/hotspots/newfoundlandandlabrador-canada/; **R-182**, PGS, Data Library Interactive Map, Website Screenshot as of 6 January 2023, available at: https://www.pgs.com/data-library/map/nsa/?lat=50.366137148404384&long=-46.20745480440965&zoom=3

[31] *See* **R-183**, TGS, Map of MC Offshore Data, Canada East Coast, Website Screenshot, as of 6 January 2023, available at: https://map.tgs.com/myTGSMap/Data-Library#55.587487,-52.926624,4z

46. Other MC marine seismic data players in Canada include CGG, which has 4,477km$^2$ of 3D MC seismic data acquired in 2000 offshore Nova Scotia. Searcher also markets 8,502 km$^2$ of 3D MC seismic data off of Nova Scotia on behalf of BP and Hess, and has reprocessed approximately 13,000 km of publically available 2D seismic data off the coast of Nova Scotia.

47. I understand that all of the companies which operate in Canada are subject to the same regulatory rules, including disclosure of data after the expiration of the applicable confidentiality period, as GSI.

### 3. **Company Size**

48. Throughout the history of the industry, size and scope of MC libraries for the asset-light marine companies and global reach of asset-heavy marine companies have had an impact on their financial success.

49. For the asset-heavy vessel owners, the ability to serve markets around the globe without expending wasteful transit time has resulted in advantage for the players with larger, globally distributed fleets. For the most part, customers will only pay for time spent on the project site while operating. Transit between projects might include mobilization fees, but in an oversupplied vessel market, oil companies are often successful in minimizing those fees through the contract negotiation process. Therefore, there are advantages to having a seismic fleet distributed near the major producing or prospective basins so as to reduce non-revenue generating time and maximizing profit. Polarcus managed a relatively small fleet (6 vessels) for many years and had difficulty competing for projects due to large transit times and costs. Polarcus declared bankruptcy in 2020.

50. For asset-light MC players, there are clear benefits to having a large, diverse portfolio of data. As described in Section (E)(2)(b) of this Part of the Report, there are location-related risks associated with MC project investment. Also, having a large, global portfolio enables a MC seismic company to be able to provide “volume discounts” to customers if customers purchase large amounts of data over many locations.

51. For both operational models, larger size and scope can increase the ability to access financing. Deeper financial resources also give access to larger budgets for important research and development programs to provide the latest technologies to their customer base.

## D. Seismic Technology

### 1. Onshore vs. Offshore

52. The majority of global seismic activity lies offshore. Data acquisition in the offshore is much more efficient and cost effective and is accomplished by large marine vessels towing single streamers and source arrays in the water in the case of 2D seismic data, or towing very large multiple streamer arrays and source arrays in the case of 3D seismic data.[32] Acquisition of seismic data onshore requires the installation and movement of sensors over large areas of land by field crews, which is very time consuming and manpower intensive. The ways in which onshore and offshore seismic data is acquired results in a much higher per-unit cost for onshore data versus offshore data.

53. The remainder of this Report will focus on the offshore seismic industry.

### 2. Offshore Technology

54. From the onset of the marine seismic industry in the 1950s, offshore seismic data largely has been acquired with ships or vessels towing arrays of hydrophones connected by cables behind the vessel in the water. In the early stages of the industry, the acoustic source was provided by the detonation of explosive charges behind the vessel and the sensors were connected via a single cable. This 2D geometry acquired data as if a single slice of information was cut through the subsurface.

55. In later years, the explosive sources were replaced with mechanical devices that released air bubbles in the water column. The oscillations of those air bubbles resulted in

[32] There is a blend of onshore versus offshore technology in areas of very shallow water, often called the "transition zone". Here, often operations are by boat, however the sensors lie on the seabed.

the acoustic signal, that after reflection from subsurface layers, was captured by the sensor arrays (streamers).

56. As the industry has developed, the size and complexity of streamer arrays have dramatically improved. In some of the most complex 3D surveys, up to 24 cables of sensors can be towed behind the vessel. The length of these streamer arrays can exceed 15 km and reach widths of over 10 km (PGS Ramform vessel design).[33] Large vessels with significant propulsion power are required to tow such arrays. With the coverage of these 3D arrays, vast subsurface areas can be covered very efficiently, giving geoscientists very dense data coverage over enormous areas, resulting in a much more cost-effective and higher-quality product over 2D data. Since 2000, technology changes have mostly been focused on streamer technology and deployment design development in marine acquisition. These changes have tended to be driven by high oil price cycles, resulting in higher seismic spend. Note that a majority of streamer advances have occurred after 2011 when the industry was recovering from the financial crisis (Figure 5).

[33] **R-184**, PGS, The Ramform Story, as of 6 January 2023, available at: https://www.pgs.com/marine-acquisition/the-fleet/ramform-story/.

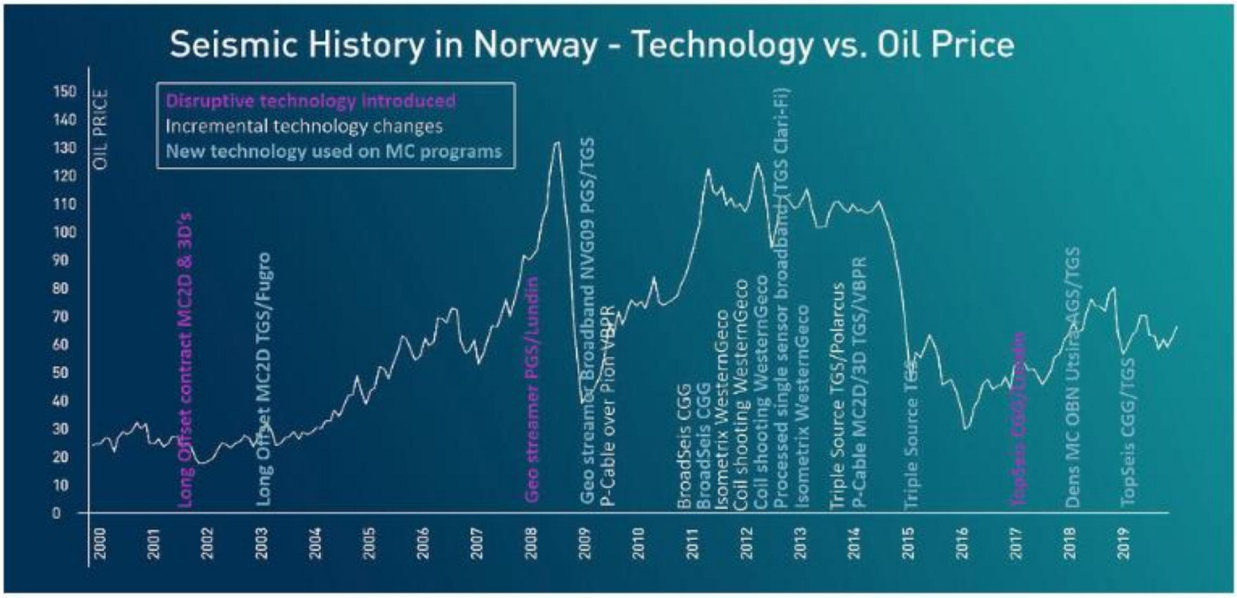



Figure 5: Chart showing important streamer advances in marine seismic acquisition.[34]

57. The large majority of GSI's data library is 2D streamer data with only a small amount in 3D.[35] In addition, given that more than half of GSI's data library was acquired in the 1970s and 1980s (which it purchased from Halliburton in 1993), it was likely recorded with older streamer technology (gel-filled streamers that included only single sensor).

58. Streamer technology available since the advent of multi-sensor streamer (2008) results in much higher signal to noise ratios and the ability to operate in much harsher weather conditions like that seen in many offshore hydrocarbon provinces (especially offshore Newfoundland and Labrador) and in the Arctic.

59. Extensive 2D and 3D data has been acquired in offshore Newfoundland and Labrador and Nova Scotia with dual-sensor streamer since 2011 (PGS and TGS). This data includes

[34] **R-185**, TGS, Seismic Acquisition and Processing: The Technology Race, 9 November 2020.

[35] **R-159**, Geophysical Service Incorporated, Acquired Data, Website Screenshot, as of 6 January 2023, available at: http://www.geophysicalservice.com/index.php?mode=webpage&id=620.

260,000 km of 2D seismic data and 55,000 $km^2$ of 3D seismic data, most of which appears to overlap with GSI's seismic data.[36]

60. Most recently, the industry has developed new methods to acquire data in deeper water where the sensors lie on the seabed (nodes). This allows the sensors (hydrophones and geophones) to connect directly with the seabed, resulting in much higher quality data. Up until recently, this type of acquisition has been much costlier. However improved technology for deployment and retrieval of the sensors has lowered the cost to a level that is approaching the cost of traditional streamer technology.

### E. Seismic Commercial Models

61. The offshore seismic industry uses two primary business models to commercialize seismic data: (1) Contract Sales ("exclusive"); and (2) Multi-client (MC) Sales ("non-exclusive").

#### 1. Contract Sales Model ("Exclusive")

62. With the contract sales model, a customer (usually an oil company) needing seismic data to conduct exploration or production development in a basin, contracts a seismic company to acquire and process a seismic survey over their area of interest. This model is also known as "exclusive" seismic data acquisition. The customer obtains the permits to acquire the data, and then tells the seismic company what technical parameters to use to acquire the data and where to acquire the survey. The customer typically pays a day rate for the vessel and crew to acquire the data and pays the seismic company on a percent-of-completion basis. After the seismic company completes acquisition and processing of the data, all data is given to the customer. Under this model, the customer owns and controls the seismic data.

[36] **R-186**, TGS, East Coast Canada, Interactive Maps, 5 November 2020, available at: https://storymaps.arcgis.com/stories/288194affdda413db49781c466e29ab0; as compared to **R-187**, Geophysical Service Incorporated, Non-Exclusive Data Offshore East Coast Canada, available at: http://www.geophysicalservice.com/Uploads/Old_Site/Offshore%20Canada%20Maps/eastcoast_comp.pdf.

63. Oil companies award work to seismic companies under the contract sales model via a tender process. The oil company discloses parameters such as the location of the survey, the size, the timing restrictions of the survey, and the desired technical acquisition parameters of the survey (e.g., 2D or 3D). The technical parameters are determined based on the target that the customer wishes the seismic company to image. The specifications can include length of streamer (offset), depth of source, size of source, streamer separation (for 3D) and near offset (distance between source and streamer). All of these specifications will change based on the focus of the project. This information is disclosed to several seismic companies, who in turn, competitively bid on the work.

64. Provided all bids are similar in terms of technology being offered and timing, then the tender process is largely based on price. Over the history of the marine seismic industry, seismic acquisition technology has been rapidly commoditized. When one seismic company innovates new technology, it is common that the oil industry tries to encourage the other seismic companies to replicate similar technology. Therefore, the competitive edge for seismic companies to win work under the contract model has predominantly been price. As projects are typically priced on day rate for a seismic vessel, then seismic companies try and seek advantage by increasing efficiency and therefore completing the same work faster and more efficiently than their competition. As a result, many participants in the industry have increased the size of their vessels (tow more streamers and sources in the water), and improved technology such as multi-sensor streamer so that streamer depths can be increased to tow in less favorable weather and sea conditions (minimize weather downtime).

65. The current remaining global 3D fleet consists of the largest, most efficient purpose-built seismic vessels in the industry. The vessels that remain in the industry's global fleet were all purpose-built in the mid-2000s for seismic operations. Previous to the collapse of the seismic industry in 2014, there were a number of old converted vessels (from the fishing industry) that were not optimum for seismic. The more recent vintage of the remaining fleet means that there is higher reliability in vessel operations. Also the newer vessels are

more efficient, meaning that on a per-kilometer basis, there are lower emissions. All of the currently active vessels in the industry were built since 1999 and only 3 of the 15 active vessels were built prior to 2010 (Figure 6, below).

Figure 6: Core Global Seismic Fleet List.[37]

### 2. **Multi-Client Sales Model ("Non-exclusive")**

66. With the MC Sales Model, also known as "non-exclusive" or "speculative" data acquisition, the seismic company holds the marketing rights to the data. The MC seismic company is responsible for obtaining the permits from the relevant authorities. The customer (usually an oil company), *the licensee*, gains access to the data by purchasing a license to use the data on a restricted basis from the seismic company, *the licensor*. This license strictly controls how the customer can use the licensed data, to whom the customer can disclose the data and under what parameters, and is a time-limited license. Two important documents control the MC seismic company and customer relationship in this model:

[37] Source: John Olaisen, ABG Sundal Collier.

1) **The Master Data License Agreement ("MLA")**: The Master Data License Agreement governs the overall licensor/licensee relationship, including all sales between the parties,[38] and is not tied to a specific survey. It is the document that specifies the rules under which the licensee can utilize any data product owned by the licensor. These rules include any parameters under which the licensee can show the data to other parties, the location where the licensee can possess the data, who can use the data and in what format the data can exist at the licensee's premises. An important aspect to most MLAs are conditions surrounding data transfer fees. Such fees are a very important source of revenue for the MC seismic companies. They ensure that if another company acquires the E&P asset under the survey through a company acquisition, then the MC seismic company gets paid a fee for an additional license (usually a discount from list price). The IAGC (now called EnergeoAlliance) maintains and updates an industry standard Master Data License Agreement, as noted above.[39] While seismic companies are not required to follow this standard, and may make some edits to fit their own needs, MLAs generally follow the same format. There is typically a considerable amount of negotiation that takes place between the licensor and licensee on specific terms and conditions before a final MLA is agreed between the parties. Items that customers negotiate usually are focused around (1) the ways in which the licensee can show the data; (2) the amount of any applicable transfer fee (discussed further in paragraph 72); and (3) whether the licensee can control what data will be included in the calculation of a transfer fee. The starting point for the seismic companies on transfer fees is that it is an "all or nothing" event versus the licensee being able to specify particular datasets. Yet this is often a negotiation point between the licensor and licensee.

2) **The Supplemental License Agreement**: This agreement indicates the specific survey being licensed under the MLA. It specifies the data being transferred and the format under which it is transferred. Each survey being licensed will have its own Supplemental License Agreement. All of the conditions agreed in the MLA apply for all of the subsequent supplemental agreements.

67. In contrast to the Contract Sales Model, the seismic company is in full control of the survey. There is no competitive tender process like in the Contract Sales Model. The ability to generate an adequate revenue stream from the work depends on whether the data is of high-quality; the data is available at the right time; the data is unique to the region (no other competitive datasets are in the area); and that there is exploration interest in the region.

[38] **R-188**, Energeo Alliance, Model Master Licensing Agreement, May 2022.

[39] **R-188**, Energeo Alliance, Model Master Licensing Agreement, May 2022.

68. The economic advantage for the licensee of the data is that the E&P company gets access to high-quality seismic data at a fraction of the cost than if the data were acquired as a contract survey. As there are multiple licensees to the survey, the cost is shared by multiple customers while the licensor (the seismic company) is able to achieve an acceptable rate of return ("ROR") on their investment.

### (a) Multi-Client Revenue Streams

69. There are two sources of revenue from a seismic company's investment in a MC seismic survey:

1) **Prefunding:** Prefunding is revenue derived from a commitment from a customer to license the survey before the seismic company starts acquisition of the survey. In exchange for this commitment, the customer normally receives a discount, is able to have limited technical input into the acquisition and processing of the data, and is assured to have access to the data as soon as the data is releasable after processing. Typically, a small percentage of the sales are collected by the seismic company before acquisition starts and standard MC accounting principles dictate that the seismic company is able to invoice the prefunding customer and book the revenue on a "percent-completion" basis as the data is being acquired and processed.
2) **Late Sales:** Late Sales (sometimes referred to as "After Sales") are revenues derived from a sale made after the survey is fully acquired, processed, and available to the general market. Pricing is typically determined from a price list built and maintained internally by the seismic company and is usually only discounted if the customer is purchasing a license with other projects owned by the seismic company. Such discounts usually follow a volume price list maintained by the seismic company.

70. The primary revenue streams from an investment in a MC survey is the pre-funding revenue recognized as the survey is being acquired and processed, and the late sales revenue that comes as the seismic company continues to sell licenses to customers during the period that the data is confidential under any applicable permit (discussed further below). Factors such as regular government-driven competitive license rounds where the data is acquired help generate a late-sales market for the data.

71. Other revenue streams may come from the activity of customers that have already licensed the data. In most high-cost offshore regions, it is quite rare that an oil company will drill an exploration well and develop a discovered field without attracting partners to help fund the project (called a "farm-in"). As discussed earlier, the licensee may be allowed under the MLA to show the data, under limited conditions, to potential partners in order to attract interest in the asset covered by a survey. If a farm-in occurs, the new company entering the partnership will be required to buy a license to the seismic data if they wish to use the data. This farm-in activity can result in a significant revenue stream for the MC seismic data company.

72. Like farm-ins, the MLA also governs how merger and acquisition ("M&A") transactions are treated. For example, in the case of an M&A transaction where one oil company acquires another oil company, and the acquired oil company holds a license to the MC seismic data, the acquiring company does not get automatic access to the data. The license is a single company license. Most MLAs specify a transfer fee price that the acquiring company will have to pay if they wish to have access to the MC data licensed by the acquired company. This transfer fee is usually a discounted rate from the list price of the data at the time of the M&A transaction. In major M&A transactions, it is rare that the acquiring company does not agree to pay the transfer fee. If the transfer fee is not paid, then the acquiring company must immediately return all data in possession of the acquired company. In some cases, the acquiring company may negotiate with the MC seismic company that certain single datasets or regions of data not be included in the transfer. However MLAs are usually written such that the transfer fee is an "all or nothing" transaction. Therefore, major oil company transactions can result in significant revenue events for the MC seismic company.

73. One of the most important activities that a MC seismic company can do to increase the value of its library is to apply new processing technology to its already-commercialized data. Reprocessing of seismic data involves taking the originally acquired data (usually the raw field data) and applying new technology to draw out new and improved information

from the original data. New reprocessing technology is continually being developed as seismic companies learn how to apply geophysical theory to large datasets through more powerful computing networks. In some cases, especially in areas of significant geologic complexity, reprocessing the data can provide a significant quality uplift. However, there are technical limits on the extent to which reprocessing can improve existing data, especially if it was acquired with older technology and stored on tape. Depending on the extent of quality uplift of the reprocessed data, a MC seismic company can encourage new customers to license the survey if the MC company can demonstrate additional prospectivity being illuminated by the new version of the data. In this case, the MC company can sell a license to the original field data to the customer (if a license to the original data is not already owned) as well as the upgraded product. It also can attract existing licensees to the data to buy the upgraded product, even if they already have a license to the original data product.

74. In jurisdictions where seismic data reports have already been submitted to the host government but do not require subsequent submission of reprocessed data (which I understand is the case in Canada), a MC seismic company can bring in new revenue by licensing the "new and improved" reprocessed data to customers without that reprocessed data becoming public after the expiration of the confidentiality period. In jurisdictions that do require submission of reprocessed data to the government for eventual public release, confidentiality period extensions may be negotiated in order to incentivize the investment required to increase the quality of the available data.

75. MC companies have invested considerable capital in computing capacity as well as manpower to be able to process and reprocess data in their libraries. For example, CGG has invested in a cloud computing network of over 250 petaflops of computing power and 200 petabytes of data storage.[40] This is one of the most powerful computing networks in the world, both private and public sectors. TGS employs around 300 employees globally

[40] **R-189**, CGG, Cloud Services, Website Screenshot, as of 6 January 2023, available at: https://www.cgg.com/digital-services/cgg-cloud-services#1702591434-1147678607

in just their MC processing group to develop and implement new geophysical algorithms for their data library. Like data acquisition costs, the costs for these resources are capitalized on the company's balance sheets to the MC library.

### (b) Drivers for Investment in Multi-Client Data

76. For a MC seismic company, continued investment is critical to preserve company value. As MC data ages, the revenue stream from existing projects in its library declines (interested customers have already purchased the data, new more technically advanced data from competition is acquired over the older projects). There are key macro considerations for a MC company when making the decision to invest in new data library products.

1) **Commodity Pricing:** This factor relates to whether oil and gas prices at a level sufficient to encourage exploration and production companies to explore for new hydrocarbon resources. Exploration spending is strongly correlative with oil price. Oil companies tend to pull back on spending to find new reserves when the oil price is low. MC seismic companies watch this closely as there has been strong correlation with Brent oil price and revenues (see Figure 7). Because of the inevitable cyclic nature of the commodities markets, the timing of investment for MC companies can be very important.

Figure 7: TGS Revenues (1994-2021) vs. Brent Oil Price.[41] Note the strong correlation.

[41] Source: Christopher Møllerløkken, SpareBank Markets.

2) **Cost of Seismic Acquisition:** While it is extremely important that commodity price trends are taken into account in making investment decisions, downturns can sometimes work to the asset-light MC seismic company's advantage when they make careful countercyclical investing (acquiring new data when seismic spending is temporarily down). For examples, countercyclical investing can allow the MC company to get vessel time more cheaply so that profitability can be maximized when customer seismic spending eventually increases.

3) **Location of Investments:** A MC company will usually focus its investments in regions in which there is a high likelihood of the occurrence of hydrocarbons in sufficient quantity. Successful MC seismic companies will employ geoscientists to understand and forecast the hydrocarbon potential of an area of investment interest prior to an investment decision being made. These geoscientists are looking at aspects of the particular basin such as: (1) the occurrence of a likely hydrocarbon source rock; (2) the occurrence of rock that is of sufficient porosity and permeability to serve as a reservoir rock; (3) the occurrence of a subsurface structure that can serve as a trap for the hydrocarbons; (4) the presence of a migration pathway to transport the hydrocarbons from the source rock to the trap; and (5) the occurrence of a sufficient seal rock to prevent the migration of hydrocarbons out of the reservoir. The MC seismic company will then use this geologic work in conversation with potential oil company customers to predict future commercial interest for the data to be acquired. This exploration work (on behalf of the MC seismic company) is important, as the company is often risking its own financial resources in undertaking the survey. If the basin in which the investment to be made is believed to not contain sufficient quantities of hydrocarbons, then the market for the data will cease to exist. The collaboration with oil companies in this decision is critical in that those interested oil companies are likely to be pre-funding candidates for the survey.

   In addition, if an unsuccessful exploration well is drilled in the region of a MC seismic company's survey, sales of that survey can decline substantially. The opposite is also true. There is nothing better for increased sales of an MC survey than to have an oil company drill a successful exploration well. Once the oil company has announced the discovery, the oil company's competitors often require a license to the survey in order to understand the reason for the discovery and determine if there is additional, similar potential on open acreage adjacent to the new discovery.

4) **Regulatory Framework:** In making an investment to obtain seismic data, the MC seismic company will consider the regulatory framework of the jurisdiction and whether it encourages exploration activity. This includes several factors:

a. An attractive economic framework (taxes and royalties) to ensure that an exploration company can reach an acceptable rate of return on their investment if a discovery is made.
b. A mechanism is in place to create a competitive market for the region's acreage. This often takes the form of exploration license rounds that the government holds for oil and gas companies to obtain rights to explore in a government's waters or land. It is particularly helpful if these rounds are held on a predictable and regular basis so that oil companies and geophysical companies can build sustainable work programs to map and understand the potential for the occurrence of hydrocarbons in the region of interest. These license rounds are particularly effective for the government if there is a competitive environment created for the acreage under offer, as the amounts bid for the acreage by the oil companies (called "bonuses") are often increased in such an environment. The competitive setting for these rounds is especially beneficial for the MC seismic company as all companies that wish to compete in the round will be encouraged to buy a license to the data as they will need the same information as their competition to properly value the acreage and have an opportunity to win the round.
c. In my experience, most governments require data disclosure after a reasonable period. This is known and understood throughout the industry. Understanding the regulatory framework and applicable confidentiality period upfront is crucial to informing a MC seismic company's investment decision and assessment of whether it can achieve an adequate ROR on its investment. After expiration of the applicable confidentiality period for the MC survey, when information submitted to the government is available for general release to the public, it will generally no longer carry any significant value to the MC seismic company, unless what is publically released is of inferior quality to what is still exclusively available under license from the MC seismic company (e.g., digital SEG-Y or raw field data) or if the data can be subsequently reprocessed and resold to new customers without immediate public disclosure.
d. The MC Sales Model has been most successful in regions that combine the certainty of a market with the geologic attractiveness of the basin in which the investment occurs.

In the federal waters of the US, geophysical data is not released to the public for at least 25 years. From a global perspective, this is a relatively long time and reflects the exploration and production maturity of the most prolific basin in the US, the Gulf of Mexico. Elsewhere around the world, such as in Norway, the United Kingdom, Australia and Brazil, data confidentiality periods last 5-15 years.

The regions mentioned in the paragraph above also have a tradition of holding regular license rounds for E&P companies to acquire acreage on which to explore. The combination of reasonable confidentiality periods and regular license round

schedules, make these regions traditionally successful markets for MC seismic data. From my experience, Canada is also a traditionally successful market, as evidenced by the ongoing investment by global companies like TGS and PGS continuing to acquire seismic data in offshore Newfoundland and Labrador.

5) **Competitive Environment in Project Area:** Sometimes multiple MC seismic companies will have an interest in acquiring similar surveys in the same basin area. This is unfavorable in that the available market for prefunding and late sales will be split between products of similar technical quality. What is more common is when a MC company will conduct a new survey over a competitor's earlier survey with more advanced technology or increased data density. This more advanced technology might include the following:
    a. More dense source or receiver points;
    b. Improved source power or penetration;
    c. Different acquisition direction that may be more in-line with the geologic setting;
    d. More advanced receiver technology than the original survey (multi-sensor versus single sensor streamer);
    e. A later survey that is a 3D volume or multi-azimuth 3D versus an earlier 2D grid or single azimuth 3D volume (improved data density and azimuthal coverage); or
    f. A survey that might include seabed node sensors. The cost for seabed acquisition is declining and MC companies are starting to invest in sparse node surveys which can result in a dramatically better image.

Density of data coverage is critical in the decision-making process of a licensor who is selecting which database to purchase if there are competing datasets. Geoscientists utilize seismic data to map subsurface structure that might be able to trap hydrocarbons. Data spacing that a geoscientist gets from a 3D volume is optimum. With 3D seismic data, the geoscientist has continuous coverage and can interpret time slices that can identify and characterize features that can be on the order of the line spacing which can be as little as 25 meters.[42]

In contrast, a 2D seismic survey provides coverage that is much lower density than that provided by 3D and therefore it is less valuable. With a 2D survey, the geoscientist might only be able to map and characterize features no smaller than 1 km in size as that is the line spacing of some of the denser 2Ds in the industry. Many 2D surveys are acquired with line spacing of 50 to 100 km (for example some of GSI's Labrador 2D surveys). These surveys are only appropriate for the geoscientist to characterize larger basin architecture and are sometimes not appropriate to image structures that are prospect scale for hydrocarbon traps.

[42] **R-190**, Öz Yilmaz, Investigations in Geophysics, Introduction to 3D Seismic Exploration, 30 September 2014.

Because they are less costly, oil companies will typically only use these regional 2D seismic surveys to establish general basin architecture to lead to conclusions that a basin might possess the elements necessary for hydrocarbons to be generated (source rock and maturity), but will require more dense 2D or 3D seismic data to identify potential drilling locations.

As long as the improvement in technology and data quality is sufficiently better, later higher-quality surveys will generally take market share from older lower quality surveys. In practice, oil companies have been willing to pay higher licensing fees to get better quality data.

As explained earlier in this Report, it is also important that once a MC seismic company has acquired a survey in a particular area that they continue to improve their competitive position in the market through the application of new reprocessing technology to their data product or through the acquisition of additional data to improve their product. It is often said that the MC seismic industry is like real estate: once a company has a data position in a basin, it is critical to make sure that the value of that data or position is constantly enhanced to discourage competition from coming into the region and acquiring a newer and better data product. One of the strategies for a successful MC seismic company is to follow its original 2D acquisition with more dense 2D or even 3D coverage. The seismic company utilizes its own previously-acquired data to optimize the parameters for the acquisition of the newer, more advanced data.

### (c) Multi-Client Project Evaluation Model

77. Once a broad decision for the investment of capital into a MC project is determined to be positive, then the MC seismic company builds a financial model (often called project evaluation model or "PEM"). The objective of this model is to forecast the expected discounted ROR of the proposed MC survey investment. The following are key inputs to the PEM:

1) **Project Location:** includes the regulatory conditions of the project area and why those conditions are favorable for investment.

2) **Survey Size:** in square kilometers for input to estimated project timelines and costs.

3) **Survey Start and End Dates:** important to define due to possible weather-related timing issues and to better define acquisition cost.

4) **Investment Life (amortized life) of Project:** typically, the standard in the industry is to amortize the projected investment over 4 years for a marine project (discussed further below). This is the time period during which the investor expects to reach their expected rate of return for the project. After that time period, the seismic data might still have some value and it would still be possible to derive revenue from licensing the data, but the revenue stream would be less certain as the years go by because the limited pool of customers will have already licensed the data as soon as it comes on to the market. In addition, the market for acreage that the survey images may be diminished as initial acreage is explored and confirmed as perspective or condemned as not likely to hold hydrocarbons.

5) **Survey Cost:** includes both the cost to acquire the data (vessel and permitting costs) and to process the data. These costs are usually capitalized on the company's balance sheet.

6) **License Unit Price:** the MC seismic company determines this price based on the number of customers that it believe will license the data while also assuring that it is not priced too high to discourage sales or encourage competition. This price must be sufficiently lower than what a customer would pay for a similar contract survey.

7) **Pre-Funding Revenue by Client and Timing of Pre-Funding Sales:** pre-funding is any commitment from a customer prior to commencement of any costs associated with the project. This definition has recently shifted to include any sale of a license prior to completion of processing (due to new international financial reporting standards ("IFRS")). Pre-funding is invoiced and cash collected on a percent-of-completion basis during the acquisition and processing of the survey. This commitment and payment schedule is very important to offset financial risk to seismic company that is making the project investment.

8) **Late Sales Forecast Revenue by Client and Timing of Late Sales:** this number is risked.

9) **Profit Per Year:** based on modelled revenues vs. amortized costs.

10) **Amortization Schedule and Calculated Rate:** this is a product of the revenue forecast and Capital Expenditure. An amortization rate is usually calculated and applied on a straight-line basis over a 4-year period (historic industry practice). This is discussed further in the next section.

11) **Cost of Capital**.

78. Based on the information above, a discounted expected ROR is calculated for the amortized life of the investment (the same as the "investment life").

79. Typically, the MC investment is approved if a sufficient risked ROR is forecasted. Companies will have their own tolerance of what is a sufficient ROR for an investment and in practice, it is often dependent on the project location and level of pre-funding. For example, in my experience at TGS, its goal was to reach a 2 to 2.5 times ROR on their investments (on a blended portfolio basis) over the life of a project based on a 4 year amortization of their investment for marine projects.[43]

### (d) Multi-Client Accounting

80. Amortization of the capital investment in a MC seismic data project is a very important concept and is standard for global marine MC seismic companies. For public companies, the total costs for the survey (acquisition and processing) can be several tens of millions of dollars. All costs to acquire and process the survey are capitalized to the company's balance sheet. Capital invested in a survey is then removed from the balance sheet over the investment life of the survey through amortization so that costs can be recognized at approximately the same time as expected sales of licenses to the survey occur.

81. In practice, license sales occur over time from the recognition of pre-funding as a percent-of-completion basis as acquisition and processing of the survey occurs, and through late sales after final processing of the survey. Delayed late sales occur because the survey is available for license to the market for a period of time after the survey has finally been processed. In basins like the Gulf of Mexico, North Sea, or even offshore Labrador, governments hold regular license rounds that encourage new participants, and therefore customers, to license seismic surveys in order to assess offered acreage. In addition, there

[43] **R-191**, TGS, Pareto Oil and Offshore Conference Presentation, September 2012.

may be transactions conducted by the oil companies (farm-ins or M&A) to these surveys that can generate further late sales.

82. MC seismic companies typically attempt to amortize the cost of surveys on approximately the same schedule as the revenue stream. This smooths the profit from an accounting perspective in the MC seismic company's books. It is industry standard to use a straight-line amortization method over a 4-year period starting from date of final data availability to the market.[44]

83. Some surveys continue to sell well after the amortization period or "investment life" from an accounting perspective. In contrast, some surveys fail to return even the original amount invested in the survey. When it is recognized that sales for a survey are not adequate to meet the original forecasts, then an immediate impairment is required on the balance sheet of the MC seismic company. Such an impairment is necessary as additional amortization is necessary to assure that the survey will be fully amortized at the end of the standard 4-year period. Publically traded MC seismic companies review their portfolio at least quarterly to assess if impairments are required.

### F. Conclusions on the Marine Multi-Client Seismic Industry

84. The offshore seismic industry is a cyclic business, whose success has largely been governed by oil and gas price. The marine seismic data acquisition industry has been oversupplied during most of its history and periods of low offshore E&P spending have directed several asset-heavy vessel-owning companies to divest of their assets and focus on the development, marketing and sales of MC seismic data.

85. These MC seismic companies can be more flexible with their cost structure (can quickly reduce investment – and cost - in tough times) more quickly than the vessel operators. As a result, there are now only two major international offshore geophysical acquisition companies and three major multi-client seismic data companies. Since 2014,

[44] *See e.g.*, **R-179**, CGG, 2021 Annual Report, p. 189; **R-177**, TGS, 2021 Annual Report, p. 37; **R-192**, Schlumberger, 2021 Annual Report, p. 46.

the industry has faced low demand relative to its high point in 2011-2012, after rebounding from the 2008 financial crisis.

86. Demand for seismic data is strongly correlative with hydrocarbon demand. Shocks to the economy such as the financial crisis of 2008-2011 and the COVID-19 pandemic in 2020-2021 can cause significant disruption to the industry and can make companies with weak balance sheets struggle to survive. This is also true during other disruptions of offshore exploration such as the dominance of onshore shale production and periods of market imbalances from an oversupplied hydrocarbon market.

87. Successful MC seismic companies make sound survey investment decisions based on geology, political risk, economic risk, competitive analysis, and the application of appropriate technology. Having access to the best geophysical technology and having the willingness to continue to invest in promising regions are also critical for a successful MC seismic company.

88. Sound financial modeling that considers all risks and is in line with local regulatory and permitting structures is critical for a successful MC seismic company. A sound investment decision must be aligned with the legal regulations and permits of the host country, or else it will fail.

## IV. OBSERVATIONS ON PWC (SHARP) REPORT AND VALUATION OF GSI

89. The purpose of the following sections is, to provide my observations on the GSI valuation approach taken by Mr. Sharp at PWC,[45] based on my professional experience and knowledge of the industry.

### A. PWC Report Assumptions

90. A "but-for" valuation of GSI's assets was performed by PWC for the claimants.

[45] **CER-02**, Expert Report of Paul Sharp, PricewaterhouseCoopers LLP, 26 September 2022 ("**CER-02**, Sharp Report").

91. Sharp utilizes an income approach to value GSI and has estimated "going concern" and "but-for" scenarios including assumed revenue and industry conditions. To estimate this revenue, Sharp uses a reference period of 2000-2012. As stated earlier, this reference period of 2000-2012 represents the growth of the offshore seismic industry from one of the lowest activity periods (2000) to one of the most active and robust periods in the industry (2012). However, it appears that GSI ceased meaningful seismic investment after 2009, and it is not disputed that the company was no longer a going concern in 2017 and 2022.[46]

92. Sharp calculates a "normalized" revenue figure (actual revenue and revenue assumed to have been lost through data disclosure) for the 2000-2012 period.[47] He then attempts to apply outside quantitative indicators to extrapolate this assumed revenue trend to the valuation dates (2017 and 2022).[48] It is interesting to note that the 2000-2012 estimated revenue trend does not correlate well with any of the quantitative indicators tested by Sharp. The strongest correlation is Global Offshore Rig Count, and that correlation had only an r-squared correlation of 0.50.[49] This correlation means that the dependent variable (revenue) only has a 50% correlation with the independent variable that they used for the extrapolation (Global Offshore Rig Count). All other indicators had weaker correlations and were not used.

93. In my view, global offshore rig count does not reflect the shift to greater production spend from exploration spend as offshore rigs are used for production as well as exploration. As explained earlier in my report in Part III, Section C, the industry has seen a severe downward trend of exploration spend versus global E&P spend since GSI's normalized revenue reference period. The average offshore exploration spend to total offshore E&P spend was 9.5% between 2000-2012.[50] This is in contrast to the same ratio

[46] **CER-02**, Sharp Report, ¶ 64.

[47] **CER-02**, Sharp Report, ¶¶ 81-98.

[48] **CER-02**, Sharp Report, ¶¶ 99-110.

[49] **CER-02**, Sharp Report, ¶ 106.

[50] *See* Figure 2: Graph showing offshore E&P spending and seismic spending in USD billions from 1991 through 2021.

of 5% for both 2017 and 2022, the valuation years used by Sharp. This indicates that more E&P spend is being allocated to production, as opposed to exploration. Given that seismic spend is historically more closely tied to exploration spend, lower exploration spend will negatively impact seismic spend.

94. Furthermore, as described earlier in Part III, Section C of the report, the offshore seismic market collapsed after 2013 and has yet to recover. Sharp's valuation of GSI on the dates of 2017 and 2022 does not take into account the significant negative market trend since the "normalized" revenue reference period of 2000-2012. This is a significant omission.

95. In fact, Sharp states that the "maintainable revenues" to 2017 and 2022 are approximately the same as that for the 2000-2012 reference period.[51] In reality, however, between 2012 and 2017, offshore seismic spending decreased from USD 8.1 billion to USD 3.5 billion (-57%). TGS revenues fell from USD 932 million to USD 492 million (-47%).[52] Therefore, it is unreasonable to expect that GSI's "maintainable revenues" remain roughly equivalent to their "normalized revenues" in the 2000-2012 period as has been done in the Sharp Report. This is especially true when one considers that the majority of GSI's data is in frontier regions versus in more developed basins as is the portfolios of comparable companies.

96. Forecasting a revenue stream for GSI into the 2017 and 2022 period also assumes that GSI had continued to invest in its data library through that period (which it did not). While TGS's revenue in 2017 was almost half of that in 2012, TGS had also continued to invest over USD 1.9 billion from 2013-2017.[53]

97. By following the real trends in the seismic industry and utilizing comparative revenues from GSI's closest competition, it is clear that Sharp has significantly

[51] **CER-02**, Sharp Report, ¶ 110.

[52] **R-193**, TGS, 2012 Annual Report, p. 2; **R-194**, TGS, 2017 Annual Report, p. 6.

[53] **R-194**, TGS, 2017 Annual Report, p. 7.

overestimated what GSI's revenues would be on the valuation dates of 2017 and 2022. If GSI had continued to invest in its library until the valuation dates, then revenues are likely to be overestimated by 2 times. As GSI has had no meaningful investment in new data since around 2008, this overestimation is likely much higher.

98. It is also interesting that Sharp assumed that all oil companies that accessed GSI's releasable data through the government would otherwise be licensees of the data.[54] It is almost certain that some E&P companies might not have licensed the data if they had been required to buy a license. Therefore, GSI's estimate of "assumed revenue" used in their valuation arguments is likely to be significantly overestimated. Sharp also fails to take into account the fact that more modern seismic data from competitors was available for license or, after the expiration of the confidentiality period, from the government regulators.

99. In addition, Sharp (CER-02, Pg. 19) applied multipliers to assumed "E&P companies" to calculate revenues that would have been collected from companies that accessed GSI's releasable data from the government.[55] Sharp justified these multipliers by stating, "…the multiplier for E&P companies is intended to capture the fact that the **same data is often licensed more than once to the same client** as a client's admission into an industry exploration group or a merger/takeover would trigger a license fee".[56]

100. However, as described in Part III(E)(2) of this report, standard MLAs in the MC industry provide for a client (or licensee) to own a license to use the data as they see fit. Only they can use the data under the license, however they are free to use it for their work as necessary. If the licensee enters into a partnership, provided that the other partners already have a license to the data or do not want access to the data, then the licensee does **not** have to buy another license. If the other partners want to use the data, they will have to buy their own licenses. Likewise, if an M&A transaction occurs, there is typically a discounted price (as defined in the provisions for transfer fees in the MLA) that the

[54] **CER-02**, Sharp Report, ¶¶ 82-91.
[55] **CER-02**, Sharp Report, ¶ 85.
[56] **CER-02**, Sharp Report, ¶ 86. Emphasis added.

acquiring company must pay if they wish to continue to utilize the data. Both of these events do not involve the licensee (or client in Sharp's description) to buy another license. Therefore the rational for the E&P revenue multipliers does not seem reasonable.

101. Likewise, Sharp applied a 3.0 times multiplier to "seismic data contractors". The rational given for this in Sharp is that the contractors would "repackage" and sell the information made publicly available by government regulators to their own customers. However, why would a customer pay for this "repackaged" information if they can obtain the data for free from the government, themselves? There is absolutely no rational for this revenue multiplier in the Sharp revenue estimation.

102. In summary, Sharp ignores the real market conditions for companies like GSI in the 2000-2022 period and has dramatically over estimated the value of the company.

### B. Impact of Competition and Location on Multi-Client Seismic Data Valuation

103. In my opinion, there are other factors impacting the valuation of GSI which Mr. Sharp has not taken into account, including specifically: (i) impact of competition, both under license and publically available from government regulators, and (ii) demand for GSI's data based on its geographic location.

#### 1. Impact of Competition

104. Maps of publically available seismic data in Newfoundland, Labrador and Nova Scotia and federal Frontier Lands indicate that data of much higher quality and density has been acquired by GSI's competitors over many years since the data was previously collected by GSI or OGSI.[57] This is particularly true in offshore Newfoundland and Labrador, Canada's most active region from a seismic and oil exploration standpoint in offshore Canada and the location of the most prolific offshore fields in Canada.

[57] *See for example*, **RWS-01**, Witness Statement of Bharat Dixit, Annex III; **RWS-03**, Witness Statement of Carl Makrides, Annexes II to VI; **RWS-02**, Witness Statement of Trevor Bennett, Annex II.

105. These maps indicate that there have been several 2D seismic surveys off the east coast of Canada that were acquired with a much denser grid than GSI's more regional grids, and that data acquired since 2011 by TGS and PGS was acquired with multi-sensor streamer (a superior technology). Furthermore, in the eastern Newfoundland and Labrador region, data from GSI's competitor data is much more suitable for mapping of prospect-scale structures. The signal-to-noise ratio of the later non-GSI data is also likely to be much higher due to the application of newer, more advanced technology. In later years, GSI's competitors even acquired 3D surveys over older regional 2D seismic data, particularly off the east coast of Newfoundland and Labrador. It is not likely that oil companies, interested in exploring in the high-cost environment of offshore Canada would license regional-scale 2D if later, higher density 2D or even 3D seismic data was present in the region of interest, certainly in 2017 and 2022 when newer data and seismic information was available either by license from a competitor or free from the government regulators.

106. In summary, not only is it more likely that oil companies would choose to license better quality data available from a competitor when it is available, but this is especially true if the confidentiality period of competitor seismic surveys has expired and information is available for free from the government regulators. Mr. Sharp has not taken into account the fact that newer and better information from competitors is also being made public on a regular basis, which could reduce or eliminate the demand for GSI's seismic surveys in the same area.

### 2. **Impact of Location**

107. As explained in Part III(E)(2)(b) of this Report, the success of a MC survey is heavily dependent on the location of the project. MC seismic companies employ geoscientists to conduct their own geologic prospectivity assessment prior to investment and the success of a MC investment declines substantially if it is determined that there is a low chance of success that hydrocarbons will be found where the investment is located.

108. Apart from the areas where more recent and superior competitor data is available, much of GSI's library consists of regional-scale 2D grids in frontier basins where little is

currently known about hydrocarbon potential.[58] In fact, some of the most dense recent 2D seismic data (2007) acquired by GSI is offshore Labrador where the Canada-Newfoundland and Labrador Offshore Petroleum Board has defined the region as "low activity."[59] By definition, this "low activity" status indicates that there is not yet a proven hydrocarbon system in the region, suggesting limited demand to license seismic data for this region. Furthermore, much of GSI's seismic data was acquired in the 1970s and 1980s in the Arctic, where calls for bids for exploration licenses are infrequent and a full moratorium has been in place since 2016.[60]

109. Mr. Sharp does not take into account that demand for GSI's data is heavily influenced not only by the factors I describe above, but whether its location is in an area that oil companies are actively seeking seismic data.

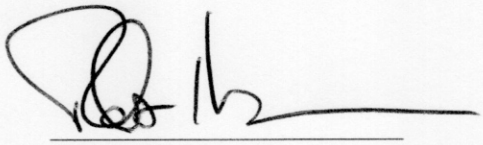
110. Unfortunately, GSI's remaining marketable data that is not superceded by competitor data is in frontier regions in which there is a high risk that commercial hydrocarbons may not be found. The market for such data and therefore its value should be heavily discounted.

### C. Conclusions on PWC Report and Valuation of GSI

111. Based on my professional experience and knowledge of the MC marine seismic data industry, I am of the opinion that the approach taken to valuing GSI in the Sharp Report is based on problematic assumptions, which do not correspond with the real market conditions in the seismic industry between 2000-2012 and ignore the significant decrease in seismic spending between 2012 and 2017. Furthermore, there are other factors impacting the valuation of GSI which Mr. Sharp has not taken into account, including specifically: (i) impact of competition, both under license and publically available from government regulators, and (ii) demand for GSI's data based on its geographic location. As a result, I am of the view that the Sharp Report dramatically overestimates the value of GSI.

[58] **R-195**, Map of Survey Regions.
[59] **RWS-02**, Witness Statement of Trevor Bennett, Annex I, "CNLOPB Jurisdiction and Land Tenure Region Map".
[60] **RWS-01**, Witness Statement of Bharat Dixit, ¶ 40.

Signed this 14th day of January, 2023.



Robert Hobbs

## V. CURRICULUM VITAE

# ROBERT SCOTT HOBBS

**Strengths**

**Leadership of an industry-leading, publically-traded global oil service company** (955 employees and almost USD 1 billion in annual revenue, traded on the Oslo Bors)
A career of **international business experience**
Extensive **capital markets** expertise
Significant **corporate governance** experience
**Technical leadership** in a major international oil exploration and production company
Leadership of organizations through **M&A transactions and integration**
**Development** of innovative **leading-edge technologies**
**Technology transfer and mentorship**

**Employment Summary**

**Shearwater GeoServices** – Chairman of the Board (November 2019 to Present)
**Live Oak Exploration, LLC** – Managing Partner (April 2019 to Present)
**Low Impact Seismic Sources (LISS)** – Advisor (January 2017 to December 2018)
**TGS NOPEC –** Chief Executive Officer (2009 to 2016) (Retired in 2016)
**TGS NOPEC –** Chief Operating Officer (2008 to 2009)
**Marathon Oil Company** – Manager, Worldwide Geoscience (2007 to 2008)
**Veritas DGC, Limited** – President/Managing Director (1998 to 2007)
**VICO Indonesia (Union Texas Secondee)** – Geophysical Specialist (1998)
**Union Texas Petroleum** – Senior Geophysicist (1995 to 1998)
**Exxon Exploration Co.**, Technology Department – Senior Geophysicist (1993 to 1995)

**Exxon Co. U.S.A.**, Exploration Dept., Offshore/Alaska Division – Senior Geophysicist (1989 to 1993)
**ARCO Oil and Gas Co.**, Western District – Geologist (1988)

**Previous Board Positions**

**International Association of Geophysical Contractors (IAGC)**
**Chairman** (February 2013 to February 2015)
Board Member (February 2008 to March 2016)

**National Oceans Industry Association (NOIA)**
**Chairman** G&G Committee (2014 to 2016)
Board Member (2012 to 2016)

**Baylor University College of Arts and Sciences Board of Advocates** (2019 to Present)

**YMCA Houston Camping Services Board (2010 to 2016)**

**Professional Associations**

Society of Exploration Geophysicists
American Association of Geologists

**Education**

University of Southern California, Los Angeles, California
Master of Science degree in Geology, 1989

Baylor University, Waco, Texas
Bachelor of Science degree in Geology, 1987
Robert T. Hill Award for Geologic Academic Excellence, 1987

**Major Positions**

***Chairman of the Board of Directors (2019-Present)***
***Shearwater GeoServices ASA, Bergen Norway***

Chair of the Board of Directors for the largest marine geophysical company in the industry. Shearwater is a privately-owned marine geophysical company with a current fleet of 23 vessels deployed around the world. Shearwater also conducts 2D and 3D seismic data processing from a number of processing centers around the world.

Leads an international Board of 6 directors.

***Managing Partner (2019-Present)***
***Live Oak Exploration, LLC, Boerne Texas USA***

Sole Proprietor consulting company specializing in investment consulting related to the Exploration and Geoscience Data Industry.

***Chief Executive Officer (2009 – 2016)***
***Chief Operating Officer (2008)***
***TGS, Houston, Texas and Oslo, Norway***

Leadership of the largest Geoscience Data Company in the world. Expanded revenues from $453 million in 2007 to $915 million in 2014. During CEO tenure, delivered shareholder return of 194% (avg. 24%/year) including two significant oil services market downturns. During tenure, TGS share price outperformed next largest publically traded geophysical company by 181%. Routinely nominated for Norwegian Financial Industry Investor Relations awards.

To accommodate growth, expanded global employee base from 531 employees in 2008 to 955 in 2016 operating in six countries.

Conducted all TGS Board Meetings (Norwegian Corp Governance precludes CEO from Board membership). Corporate activity necessitated an average of 8 Board meetings per year, which included two bi-annual strategy workshops. Prepared all Board materials including committee briefs.

***Manager, Worldwide Geoscience, Technology Services***
***Marathon Oil, Houston, Texas (2007)***

Responsibility for global geoscience technology support within Marathon. This involved leadership of a team of 46 technical professionals that provided global technology support for the exploration and production departments. Services provided include seismic data processing and acquisition planning, interpretation application and database support, and reservoir characterization.

***President and Managing Director***
***Veritas DGC Limited, United Kingdom (2004 – 2007)***

Responsibility for the entire business of a wholly-owned subsidiary of Veritas. This $140 Million business was responsible for all of Veritas' product lines in the Europe, Africa, Middle East, and Former Soviet Union. Approximately 620 employees were in this division. This division was active in acquiring, processing, and interpreting marine and land seismic data in addition to developing and marketing and extensive data library. This position reported to the President and COO of Veritas Geophysical Corporation, Headquartered in Houston, Texas.

***President***
***Veritas Exploration Services (2002 – 2004)***

Responsibility for managing and leading a worldwide division of 98 employees successful at providing industry-leading reservoir characterization and subsurface interpretation services and software. Responsible for annual revenue of $17 Million. Built a profitable business from a money losing organization ($4.6 million annual loss) within a nine-month period. Involved leadership of both a geophysical software business (Hampson-Russell) and subsurface consulting businesses (VES and HOT Engineering).

***Vice President, Exploration Products***
***Veritas Marine Surveys (2000 – 2002)***

Responsibility for project development and sales for non-exclusive interpretation and derivative products. Product responsibility included deep-water Gulf of Mexico multi-client pre-stack depth migration projects ($56 Million in sales as of YE2002), non-exclusive reservoir characterization, and AVO products for North and South America. Primary responsibility for assessing exploration and commercial risk for data library products throughout North and South America.

***Vice President, Exploration Ventures***
***Veritas Exploration Services (1998 – 2000)***

Managed a team of nine geophysical and geological interpreters and data administrators. Developed and completed projects ranging from non-exclusive PSDM interpretation products, data library project development, and prospect analysis for non-exclusive project risk assessment.

***Geophysical Specialist***
***Vico Indonesia (Union Texas Secondee); 1998, Jakarta Indonesia***

3D Seismic interpretation and prospecting in the Kutai Basin, Onshore Kalimantan, Indonesia (1998-present). Responsible for the generation of exploration prospects and field offset well locations on the east flank of the Sanga-Sanga Anticline.

***Senior Geophysicist***
***Union Texas Petroleum, Exploration Department; 1995 – 1998, Houston***

2D Seismic interpretation and prospecting in the Pri-Caspian Basin, Onshore Kazakhstan: Assisted in the evaluation and farm-in to a 16,600 sq. km. exploration permit. Designed, tendered, and permitted a 1,360 km 2D seismic survey to image traps under and against highly deformed salt bodies after acreage acquisition.

2D Seismic interpretation, play and prospect mapping, Pelagian Basin, Offshore Tunisia (1995-1996): Mapped and built a seriatim of prospects in a 4700 sq. km. exploration permit in the Pelagian Basin. Work included carbonate reservoir prediction utilizing post-stack and pre-stack seismic inversion techniques. This project resulted in a late 1997 – early 1998 UTP exploration well.

***Senior Geophysicist***
***Exxon Exploration Company, Technology Department - Complex Imaging and Interpretation Group; 1993-1995, Houston***

3D Structural Interpretation of subsalt opportunities, Gulf of Mexico, USA (1993-1995): Structural interpretation of 3D seismic surveys over 10 opportunities on the Louisiana shelf and slope. Mentored business unit seismic interpreters in the areas of velocity model building and 3D post-stack and 3D pre-stack depth migration over these opportunities.

2D Seismic interpretation, play and prospect mapping, Pri-Caspian Basin, Kazakhstan (1993-1994): Involved identifying and assessing in excess of 40 exploration and production opportunities in the clastic post-salt and carbonate subsalt plays of the Pri-Caspian Basin from a 2D seismic database of 12000 Km. This assessment required extensive work onsite with Kazakh National oil companies in Uralsk and Aktubinsk Kazakhstan.

2D Seismic interpretation and play mapping, Carpathian Fold-Thrust Belt, Ukraine (1994): Interpreted 900 km of 2D seismic and developed a regional structural framework for the Carpathian belt near the Lopushna and Borislav oil fields.

2D Seismic interpretation and prospect mapping, Offshore Nigeria (1992): Stratigraphic/Structural interpretation of 4000 Km of 2D seismic and development of amplitude anomaly opportunities in the deep-water play, Offshore Nigeria. Contributed to the acquisition of a significant interest in several concessions.

***Senior Geophysicist***
***Exxon Co., USA - Offshore/Alaska Division - Subsalt Team; 1991-1993, Houston***

2D and 3D seismic interpretation, play and prospect mapping, Gulf of Mexico Subsalt Play (1992-1993): Built the regional stratigraphic and structural framework for the subsalt play on the Louisiana shelf through the integration of log, paleo, 2D and 3D seismic data. This project established the foundation for Exxon's future efforts in subsalt opportunity acquisition.

***Geophysicist***
***Exxon Co., USA - Offshore/Alaska Division - Technology Applications Group; 1989-1992, Houston***

Gulf of Mexico Amplitude Anomaly Assessment (1990): Coordinated and conducted a project to identify, catalog and assess amplitude anomalies on the entire Gulf of Mexico slope from the company's 2D and 3D seismic database. The assessment resulted in the identification of 12 opportunities, 2 of which were ultimately acquired by the company.

Gulf of Mexico Hydrocarbon Assessment (1989-1990): Performed a basin-wide, play-based hydrocarbon assessment of the Gulf of Mexico.

***Arco Oil and Gas, Western District; 1988, Bakersfield, CA***

Summer Professional Geologist: Completed a study of the petroleum geology of a Monterey Formation field, Santa Barbara Channel, offshore California.

**Industry Training**

Applied Seismic Interpretation (Exxon)
Basic Well Logging (Exxon)
Basic Clastic Facies (Exxon)
Fundamentals of Structural Analysis (Exxon)
Applied Subsurface Mapping
Quantitative Structural Analysis Techniques for the Balancing and Restoration of Compressional Structures (Exxon)
Quantitative Structural Analysis Techniques for the Balancing and Restoration of Extensional Structures (Exxon)
Seismic Modeling for Structural Interpreters
Structural Analysis: Compressional Tectonics (Advanced) (Exxon)
Leadership I (Exxon)
Carbonate Sequence Stratigraphy (AAPG)
Deepwater Sedimentology (Exxon)
Negotiation Skills (Veritas)
Advanced Marketing (Veritas)
Leadership Skills (Veritas)
Pricing Strategies (Kellogg School of Business)
Leadership at the Peak (Center of Creative Leadership)
Veritas Global Leadership Program (Rice University)
Marathon Visionary Leadership Program

**Publications**

Hobbs, R. S., (2001) Depth Imaging in Collaborative Visualization Environments: *Sea Technology*, December 2001

VerWest, B., Liang, J.D., Hobbs, R.S., Young, J. (2001) Multi-Directional 3D Acquisition and Processing for Subsalt Imaging: Society of Exploration Geophysicists Annual Convention, San Antonio, Texas.

Hobbs, R. S., Young, J., Ver West, B., (2001) Multi-Directional 3D Acquisition and Processing; Salt Imaging, Deepwater Gulf of Mexico: American Association of Petroleum Geologists Convention, Denver Colorado.

Hobbs, R.S. (2001) The Use of Collaborative Visualization Environments for Complex Depth Imaging: 2001 Offshore Technology Conference, Houston, Texas; OTC Paper 13009

Hobbs, R.S., Bankhead, B., (2000) Advances in Seismic Interpretation, 1990 - 2000: Premier Magazine

Talling, P.J., Lawton, T.F., Burbank, D.W., Hobbs, R.S., (1995) Evolution of latest Cretaceous-Eocene non-marine deposystems in the Axhandle piggyback basin of central Utah: *GSA Bulletin*, v. 107; no. 3; p. 297-315.

Talling, P.J., Burbank, D.W., Hobbs, R.S., Lawton, T.L., and Lund, S.P., (1994) Magnetostratigraphic chronology of Cretaceous to Eocene Thrust Belt Evolution, Central Utah: *Journal of Geology*, v. 102, p. 181-196.

Burbank, D.W., Beck, R.A., Raynolds, R.G.H., Hobbs, R.S., Tahirkheli, R.A.K., (1988) Thrusting and Gravel Progradation in foreland basins: A test of post-thrusting gravel dispersal: *Geology*, v. 16; p. 1143-1146.

Allen, P.M., Hobbs, R.S., Maier, N.D., (1988) Downstream impacts of a dam on a bedrock fluvial system, Brazos River, central Texas: *Society of Civil Engineers*.