

# Total

As new oil and gas reserves become more elusive, companies like Total rely increasingly on high performance computing (HPC) to find opportunities in an ocean of seismic data. With SUSE® Linux Enterprise Server as the operating system for its new SGI supercomputer, Total enjoys the optimal combination of performance, price and efficiency. The solution—Pangea—delivers ten times the computing capacity of the system it replaced, helping Total identify and exploit new reserves more effectively.



### Overview

Total operates in 130 countries worldwide and is the fifth largest publicly-traded integrated oil and gas company. In addition to downstream activities in refining, marketing, trading and shipping of crude oil and petroleum products, Total has upstream exploration and production capabilities in more than 50 countries.

### Challenge

The era of easy and cheap oil and gas is largely over, and production from mature fields is either plateauing or falling. The earth still has plenty of reserves, but they are increasingly discovered in less easily exploitable forms, such as oil shale, or in less accessible locations. In particular, the chances of finding large reserves in a single location are falling, reducing the likely yield and increasing the cost-per-barrel for new sites.

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**DIEGO KLAHR**  
HPC Engineer  
Total

For Total Exploration & Production (Total E&P), the challenge is therefore to continually improve its ability to locate new reserves and cost-effectively bring them into production. This process depends heavily on the computer-aided analysis and visualisation of huge sets of seismic data, which is gathered by generating waves of vibration and measuring how hidden geological structures reflect them.

With the goal of being able to discover and exploit smaller and less accessible reserves, Total E&P set out to improve the resolution of its visualisations, which meant significantly increasing the computational power at its disposal.

### Solution

Following a public tender, Total E&P selected SGI to build a new supercomputer called “Pangea”, based on the SGI ICE X High Performance Computing platform and including innovative M-Cell water cooling.

Diego Klahr, HPC Engineer at Total E&P, said: “Like the other vendors, SGI proposed a commercial distribution of Linux—in their case, SUSE Linux Enterprise Server—arguing that this would enable better integration with SGI Management Center for ICE X. We saw that this would indeed be a big technical plus.”



### Total at a Glance:

*Total is the world's fifth largest publicly-traded integrated oil and gas company.*

#### ■ Industry and Location

Agriculture and Mining—Oil and Gas, France

#### ■ Product and Services

SUSE Linux Enterprise Server

#### ■ Results

- + Raised computational performance, enabling faster simulations
- + Enabled 10-times increase in computing capacity
- + Optimised price-performance, keeping TCO as low as possible

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Total E&P benchmarked its own applications on SGI's proposed solution, and found that the combination of SGI hardware and the SUSE Linux Enterprise Server operating system would offer the best performance as well as the best price.

“We clearly saw that the price-performance of SUSE Linux Enterprise Server on the SGI platform was better than the competing OS options,” said Diego Klahr. “And from our point of view, SGI plus SUSE Linux Enterprise Server was a complete, integrated solution.”

Pangea is a 2.3 PFlop distributed-memory supercomputer with 110,592 Intel Xeon E5-2670 processor cores and 442 TB of memory. Each node runs a separate instance of SUSE Linux Enterprise Server in a fully parallelised environment managed by SGI Management Center for ICE X. At the time of writing, Pangea is one of the two highest-performing supercomputers worldwide according to the Top500 list ([www.top500.org](http://www.top500.org)).

“Pangea is an extremely powerful solution for running numerical models in support of three-dimensional visualisations of subterranean geological formations,” said Diego Klahr. “Using the system, we can run ten times the number of simulations we run with our previous supercomputer, helping us to identify potential deposits and determine the best extraction methods more easily.”

## Results

The combination of SUSE Linux Enterprise Server with SGI hardware, cluster management software and deployment services

has given Total E&P a supercomputer that is both powerful and highly efficient. The SUSE Linux Enterprise Server operating system provides a fast and stable platform for Total E&P's specialised applications, and its small footprint helps to maximise performance by minimising the overhead on the Xeon processors.

“We also ran SUSE Linux Enterprise Server on our previous supercomputer, so it was not surprising to see the strong performance and stability of the platform,” said Diego Klahr.

To boost the energy-efficiency of the solution, and keep operational costs as low as possible, SGI used its M-Cell design, which provides a closed-loop airflow and warm-water cooling to contain heat within a hot aisle, thereby reducing total cooling requirements.

“The efficiency of the SGI ICE X system, which represents high computational power using a minimal amount of energy, gives Total the smallest footprint and lowest TCO possible,” said Philippe Malzac, CIO of Total E&P.

As computing requirements at Total E&P continue to grow, Diego Klahr is confident that SUSE Linux Enterprise Server will rise to meet the challenge: “As we look to model the physical world in ever more detail, SUSE Linux Enterprise Server gives us the ability to keep scaling on ever larger machines, ensuring that we can keep evolving our capabilities.”



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