

Why Choose

Californium-252 Over Neutron Generators?



Frontier Technology Corporation
WORLD'S EXPERT IN NEUTRON SOURCES

An Overview of Neutron Sources & Californium-252



Neutron sources are materials or devices that emit neutrons – this can happen through a number of mechanisms. Based on their size, neutron sources can be classified as small, medium, or large devices. These devices play an important role in scientific research and also support critical applications in the nuclear, oil and gas, and military and defense industries. The most widely used neutron source in these industries is [californium-252 \(Cf-252\)](#), a radioactive isotope of the californium element.

Classified as a small-device neutron source, Cf-252 is an extremely strong neutron emitter that is produced in the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL) or in particle accelerators. It has a silvery-white metallic appearance and is typically sealed within single- or double-encapsulated containers for safe usage in applications. As a synthetically made element that is never found in nature, Cf-252 comes at a relatively high upfront cost. Highly specialized facilities and procedures are required for its production, and the finished product must be packaged and shipped in [Type A shipping containers](#) to ensure safe transportation.

This eBook provides an overview of Cf-252's advantages over neutron generators and why you can expect a quick and worthwhile payback despite a higher initial investment.

Key Advantage #1: Powerful Neutron Emission

A single microgram of Cf-252 can emit a remarkable 170 million neutrons per minute, making this isotope a great primary and secondary start-up neutron source for nuclear reactors. When used within startup rods, Cf-252 undergoes spontaneous fission and delivers a strong, stable emission of neutrons that triggers uranium and other fuels to initiate the fission reaction process.

Unlike neutron generators, Cf-252 neutron sources provide a powerful output of neutrons despite their relatively small size. While smaller-sized neutron generators are available, they produce a comparatively lower volume of neutrons that is often inadequate for meeting the demands of critical applications in nuclear, military and defense, and research-related industries.



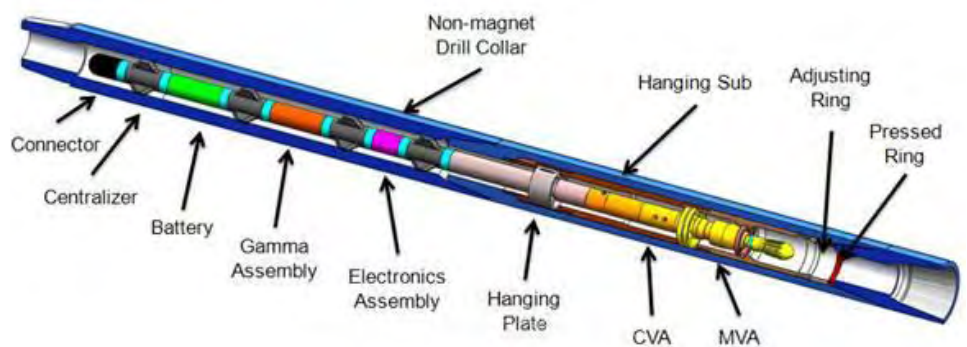
Key Advantage #2: On-Site Material Analysis

Cf-252 neutron sources offer quick and convenient on-site analyses of coal, cement, minerals, oil and gas, and other materials, providing immediate material composition data. It also offers its analytic power to the military and defense industry through rapid detection and evaluation of explosive devices (find more information about this in the PINS section below). This saves a significant amount of time by eliminating the need to transport samples to laboratories or facilities for examination. In material analysis applications, Cf-252 neutron sources work by bombarding the samples with high volumes of neutrons to trigger the emission of gamma rays. Since each element has its own unique gamma-ray signature, the resulting output can be analyzed with specialized equipment and software to provide compositional information.

Several material analysis procedures rely on Cf-252's powerful neutron-emitting capabilities, including:

- **PGNAA.** Prompt-gamma neutron activation analysis (PGNAA) is a non-destructive process that evaluates samples of varying sizes to determine the types and amounts of elements present. During the PGNAA process, Cf-252's neutron beams irradiate the sample while a spectrometer analyzes the resulting gamma rays to determine the material's composition.
- **PINS.** In the military and defense industry, portable isotopic neutron spectroscopy (PINS) systems use a Cf-252 neutron source along with specialized software to identify explosives, chemicals, nerve agents, and other hazardous materials inside suspicious containers or munitions without having to open them.
- **Oil well & borehole logging.** In oil well and borehole logging applications, Cf-252 emits high-energy neutrons that bombard the walls of the formation, providing critical information on the features and properties of the borehole. This helps determine the feasibility of safely and efficiently drilling the site for the extraction of hydrocarbons.

Part of what makes Cf-252 neutron sources so versatile is that their containers can be customized and configured for integration with specific types of equipment. They also require no external power supply, allowing the equipment they support to be easily transported via truck or carried by hand. This design flexibility is essential for PINS systems, oil well logging instruments, and other mobile equipment where large neutron generators would be impractical.



Key Advantage #3: Resilience, Dependability, and Safety

When using Cf-252 neutron sources, you can expect:



Resilience. Cf-252 neutron sources have the benefit of being virtually indestructible in most operating environments. With the correct shielding, their properties and efficiencies are largely unaffected by temperature extremes, high-vibration conditions, and other demanding environments.



Dependability. Compared with neutron generators, Cf-252 neutron sources provide a more reliable and longer-lasting source of neutrons. Neutron generators have a larger potential for unexpected failure, which reduces the reliability of the entire operation. In addition to being prone to malfunctioning, neutron generators require neutron tubes that tend to burn out quickly. The costs of frequently replacing these tubes and other parts can offset the generator's initially low price.



Safety. When packaged, handled, and disposed of properly, Cf-252 neutron sources are secure and environmentally safe.

With the importance of Cf-252 to scientific research, nuclear power generation, and other critical applications, steady production of the isotope can be expected for the foreseeable future.

The Differences Between Californium-252 & Neutron Generators

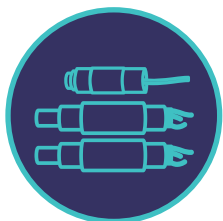
Neutron generators produce neutrons through the fusion of hydrogen isotopes.

These systems primarily consist of an external power source and linear particle accelerators known as neutron tubes. They facilitate fusion reactions by accelerating deuterium, tritium, or a combination of these isotopes into a metal hydride target containing the same isotopes. Deuterium-deuterium or deuterium-tritium fusions create heavier isotopes of hydrogen and a release of extra neutrons.

When considering a neutron generator for an application, the following factors should be kept in mind:



Importing difficulties. If you are looking to place an international order for a neutron generator, it is important to consider your home country's importing rules and tariffs on specific goods. Tariffs are placed on specific Schedule B codes within the Harmonized System (HS), and these can vary (and change over time) per country. Neutron generators are categorized as electronics, which may result in a difficult and/or costly importing process for certain countries. It is absolutely critical for you to first check into whether or not you will be able to import neutron generators successfully.



Neutron tube expenses. While neutron generators are often marketed as cheaper alternatives to Cf-252, frequent replacement of their expensive neutron tubes can make them less cost-effective in the long run.



Frequent maintenance. With more parts than Cf-252 neutron sources, neutron generators tend to break down more easily and require frequent maintenance to operate efficiently.



Design limitations. The large size and weight of neutron generators make them unsuitable for certain applications that require a more compact design. Although smaller neutron generators are available, their applications are somewhat limited by their low neutron yields.

In comparison to neutron generators, Cf-252 neutron sources are much less complicated in design and are consequently easier to use and cheaper to maintain. These versatile devices are capable of providing a continuous output of neutrons for years before a replacement is required. Cf-252 neutron sources can also produce comparable or higher neutron intensities at a much smaller size than neutron generators, which is important when designing instrumentation that must fit into narrow-diameter boreholes (i.e. for oil well logging applications) and other confined spaces.



Californium-252 Neutron Sources at Frontier Technology Corporation

Californium-252 is a powerful, resilient, and versatile neutron source that can be customized for easy integration into a range of nuclear, oil and gas, minerals, military and defense, and material analysis equipment. Despite an initially higher price, Cf-252 offers several clear advantages over neutron generators that make it the more cost-effective option in the long run.

With nearly 40 years of industry experience, [Frontier Technology Corporation \(FTC\)](#) is a global leader in designing, manufacturing, and safely shipping Cf-252 neutron sources for the nuclear, oil and petrochemical, and military and defense industries, as well as for academic and research requirements. We offer a range of single- and double-encapsulated containers in a wide range of customizable configurations, ensuring seamless integration with your equipment. Every product we manufacture is thoroughly tested and inspected in accordance with strict quality assurance protocols.



Find more information about our [californium-252 neutron sources here](#).

To learn more Frontier Technology Corporation's services and capabilities, [reach out to us](#) today.



About Us

Frontier Technology Corporation (FTC) is the world leader in californium-252 neutron source manufacturing and design, and is the foremost expert in logistics and shipping of radioactive material.

Founded in 1984 by Treva Janzow and the late Edward Janzow, Frontier Technology is located in Xenia, Ohio. Frontier Technology has over 40 years industry experience in providing the highest-quality neutron sources, PINS sources, nuclear start-up rods, TYPE-A shipping containers, WEP shielding, and antimony-beryllium pellets.

[Contact Us](#)

[Visit Our Resource Library](#)

