

# Reducing Sulfur Hexafluoride Use at LANSCE

Hank Alvestad presents to the  
Fugitive Emissions Working Group

September 8, 2011

LA-UR-11-05069

# Los Alamos Neutron Science Center (LANSCE)

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# LANSCCE History

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- Since 1972, the 800-million-electron-volt accelerator and its attendant facilities at LANL have been a resource to a broad international community of scientific researchers. The facility hosted about 1000 users per year to perform medium energy physics experiments.
- In 1977, a pulsed spallation neutron source was built to supply neutrons for neutron scattering experiments. The facility was later expanded to other spallation sources on the accelerator beam. The Proton Storage Ring that compresses proton pulses from 750 microseconds to a quarter of a microsecond was completed in 1985.

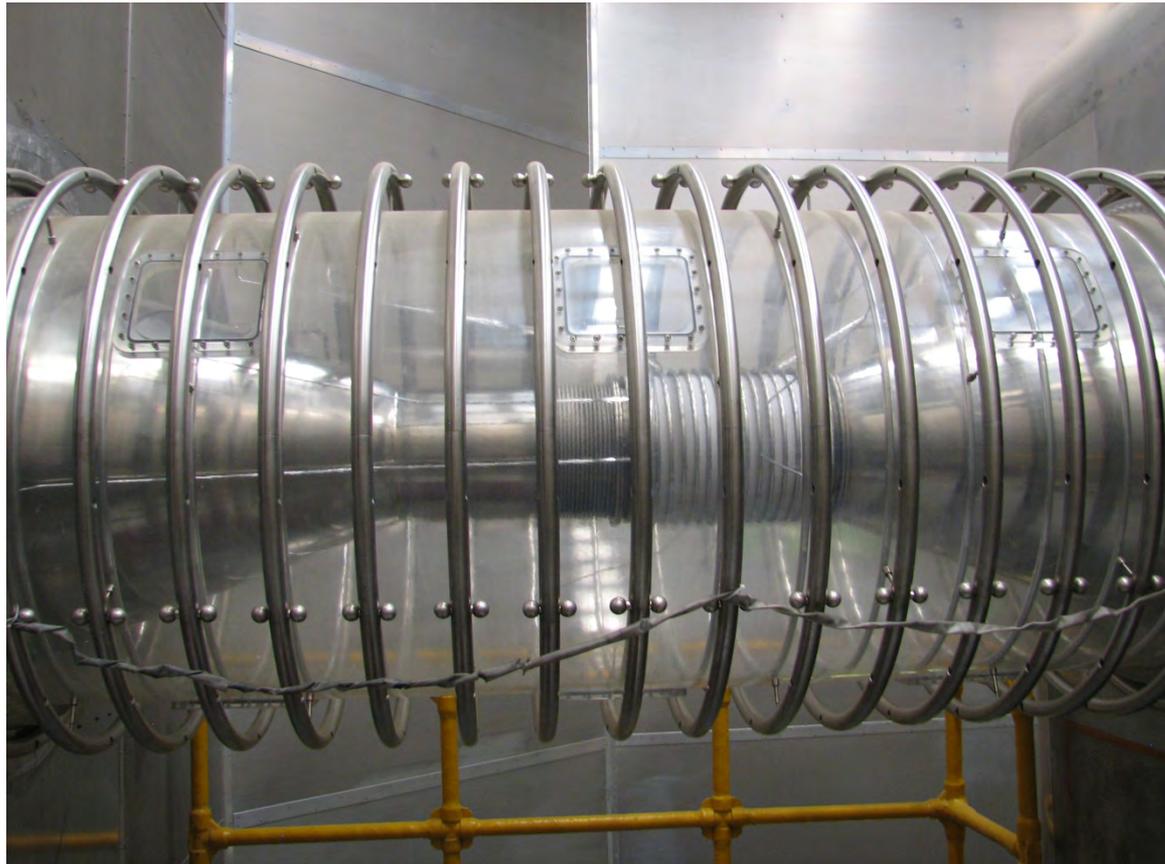
# Ion Sources

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- Near the beginning of the LANSCE accelerator there are two high-voltage DC injectors for the two ion sources. One ion source produces H<sup>-</sup> ions and the other produces protons.
- Both use sulfur hexafluoride (SF<sub>6</sub>) as an insulating gas to prevent internal electrical arcs, and each contains about 40lb of SF<sub>6</sub> in approximately 104ft<sup>2</sup>.

# DC Accelerating Column

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# Electronics Issues

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- For many years, electronic components within the SF<sub>6</sub> jacket would become tarnished and frosted over time and would require replacement when the inevitable failure occurred.
- The failures usually required at least two days to repair, and the cost to researchers trying to use the accelerator was approximately \$240,000 per day in lost time. In addition, LANSCE incurred costs for new components.
- Fixing the components is difficult for personnel due to very limited space.

# Sulfur Hexafluoride Replacement

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- LANSCE technicians changed out the SF<sub>6</sub> within the accelerating column jacket 3-4 times per year upon electronics failures, and this process takes about 2 days.
- Repairs required SF<sub>6</sub> removal through hoses in the bottoms of the jackets and was released outside and lost to the atmosphere. When repairs were completed, the air in the jacket was displaced with new SF<sub>6</sub>.
- This was a wasteful, expensive process. Approximately 80lb of SF<sub>6</sub> was lost each time.

# Problem Identified

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- LANSCE consulted with industry and a company called DILO. Hank realized that the electronics problems were being caused by the presence of hydrofluoric acid (HF).
- HF is a contaminant that can form when any oxygen or water vapor is present in the SF<sub>6</sub>.
- Another trace contaminant that can form under these conditions is phosgene, a potent toxin formerly used as a nerve gas.

# Ultrapure Sulfur Hexafluoride

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- In early 2008, DILO purified SF<sub>6</sub> for LANSCE to prevent the electronics problems associated with low levels of contamination from oxygen and water vapor.
- To remove all of the existing atmosphere, large volumes of ultrapure nitrogen, which is quite inexpensive and environmentally benign, were flushed through the jackets. Having some ultrapure nitrogen mixed in with the new ultrapure SF<sub>6</sub> does not pose any contamination issues.
- The jacket is then filled with one volume of ultrapure SF<sub>6</sub>.

# Success!

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- Since the ultrapure SF<sub>6</sub> was originally put into the jackets, no maintenance has been required.
- Over three years have passed without any components failing and without wasting precious time for the researchers.
- At ~\$4/lb for SF<sub>6</sub> purification charges, it is quite a bargain when compared against the enormous benefits that have been realized.
- When released, 80lb of SF<sub>6</sub> has the global warming equivalent potential of over 1.8 million pounds of CO<sub>2</sub>.

# Future Plans

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- In case of a future electronics failure, the ultrapure SF<sub>6</sub> may need to be replaced. It is unclear how long the original ultrapure SF<sub>6</sub> will remain uncontaminated in the jackets.
- In preparation for potential gas replacement, LANSCE is planning to buy equipment to capture the SF<sub>6</sub> for re-purification and reuse instead of releasing it outside as was done previously.

# Questions?

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