HALON 1301 USE IN OIL AND GAS PRODUCTION FACILITIES ALASKA'S NORTH SLOPE

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ABSTRACT
The North Slope of Alaska is home to the United States' two largest oil fields. The unique aspects of producing oil and gas in the harsh conditions of the arctic environment required innovative engineering design to reduce exposure to traumatic injury to employees, as well as property loss. Halon 1301 is a critical component to safe production in totally enclosed arctic facilities, representing a capital investment of over $20 Billion. With the introduction of the Montreal Protocol and the United States Clean Air Act, alternatives to Halon 1301 will be necessary. Critical factors, ranging from toxicology to characteristics of explosion prevention, must be considered as an alternative chemical is developed.

INTRODUCTION

In 1968, the largest oil field in North America was discovered - the oil reservoir existing about 8,500 feet below the frozen tundra of Alaska's North Slope.

With this discovery, and the finding of subsequent smaller fields in the same geographical location, innovative oil and gas proauction techniques had to be designed - not the least of which **was** the protection of people, property, and the environment.

Up to the opening of the great Prudhoe Bay Field, there was a firm foundation of traditional methods of production and, concurrently, safety, health, and environmental protection techniques. However, very few of those traditional methods were applicable to the hostile environment of the Arctic North Slope Region of the state.

In most production scenarios around the country, oil and gas production takes place in an open air environment, where hydrocarbon process exposure is minimized with respect to personnel. In the Arctic regions of Alaska however, these traditional methods of production had to be contained in environmentally protected enclosures where the exposure to traumatic injury, or significant property damage, was greatly increased.

Where we once had oil, gas, and water separation equipment in remote locations, with relatively few people in close proximity, we now were confronted with housing this equipment in the same room with people.

To give a perspective of the magnitude of the oil, gas, and produced water production on Alaska's North Slope, every day there are over 1.5 million barrels of crude oil processed into the Trans-Alaska Pipeline. To maintain this production level, over 3 billion cubic feet of natural gas must be removed and processed each day, including the production of up to 50,000 barrels of natural gas condensate. We must also handle millions of barrels of produced water and generate our own electrical power. Facilities had to be built to accomplish all of this in a safe manner.

Today, up to 25% of the United States' oil production comes from the North Slope of Alaska by way of five oil fields. Two additional fields are being made ready to brought on line in the next few years. These fields are operated by ARCO Alaska, BP Exploration Alaska, Inc, and Conoco, with the Trans-Alaska Pipeline System being operated by Alyeska Pipeline Service Company. Over 2,000 production personnel and support contractors are involved each day in maintaining production rates. It is the protection of these people that has made Halon 1301 a critical chemical for our use.

HALON USE ON THE NORTH SLOPE

When engineer's were confronted with the enormous technological challenges of producing oil in the arctic, of prime importance was the search for acceptable risk levels involving the direct exposure of people within an enclosed process area. Of secondary importance was the development of a casualty control system to reduce possible property and environmental damage.

With respect to life/safety concerns, the foremost challenge was to try to reduce the chance of a major fire or explosion in the event of a hydrocarbon release.

A sophisticated system of hydrocarbon gas detection was designed through the use of existing technology of gas detector heads, UV detection, and UV/IR dual discriminating optical detectors. Additionally, a thermal detection network is installed for class **A** fire alert. The current facilities on the North Slope will have at least one of these gas detection technologies, depending on the operating company's criteria existing at the time of the facility was designed. Obviously, as technology improves, the major oil companies take advantage of that as each new generation of facilities is commissioned.

Literally thousands of detectors are in active use at any point in time. Depending on the operating philosophy of the operating company, the gas detectors are set with a low level of anywhere from IO-25% of the Lower Explosive Limit (LEL) and an upper limit of 60-80% of the LEL.

Upon detection at the lower limit of any two gas heads within a fire zone, or two cross-zoned UV or UV/IR optical detectors, **HVAC** systems will increase the air changes per hour, usually going from four air changes to eight or twelve changes per hour. This increase in dilution rate hopefully will keep the hydrocarbon levels low, however if the levels continue to increase to the point an upper limit of LEL is detected, then the HVAC shuts down and the local fire zone receives a release of Halon 1301. A release can also be initiated through a manual activation by any facility employee.

The volume of the released halon is such that it will typically mix at 7.7% by volume, and in most cases we design in a margin of error of 10% of the necessary halon quantities, such that we may exceed 8% in some cases. This **is** well below the recommended limits for human exposure. Through the use of positive pressure differential between fire zones, coupled with designed seal integrity for the zone, the halon-air mixture will remain effective up to 30 minutes. This allows people to safely evacuate the area and also allow some time for leak mitigation teams to correct the situation if they must reenter the area. These zones meet Class 1, Division 1 electrical standards which reduces possible sources of ignition in the process area. Other operating procedures similarly reduce ignition sources. In the event of hydrocarbon leakage, the primary use of Halon 1301 is to reduce the likelihood of explosion - therefore it is **an** explosion prevention tool, not to be confused with explosion suppression uses of halon.

Our total release time in any one fire zone is geared to around 10-15 seconds which is entirely too slow for explosion suppresion.

In the vent of a Class A fire, halon will be released if a single thermal detector senses a rate of rise in temperature.

To give perspective to the amount of Halon 1301 required to be readily available in existing fixed total flooding systems, it is estimated that there exists over 600 individual fire zones in process facilities currently in use. Some of these fire zones incorporate over 350,000 cubic feet of exposed volume. Halon inventory reports estimate that current in-place total flood systems have over 3.5 million pounds of Halon 1301, with a warehouse reserve of about 100,000 pounds. We have been advised by halon suppliers that the Alaska North Slope may be have the largest volume of halon stocks in the United States outside of the military.

HALON 1301 RELEASE HISTORY

In late 1989, BP Exploration, ARCO Alaska, EXXON, and Alyeska Pipeline Service Company formed **a** committee to ascertain in a cooperative manner the impact of the Montreal Protocol and the United States Clean Air Act on our operations.

One of the efforts involved with this undertaking was to begin collecting data on halon releases. Although this data is being fine-tuned **up** to this point in time, it has revealed some interesting highlights. The first key point is that the vast majority of halon releases were not for cause, that is, the release was due to a malfunction in the detection logic, detection equipment, or human error. **A** second interesting point is that those releases for cause were rarely related to fire suppression. This supported the primary purpose of Halon 1301 systems - explosion prevention, not fire suppression. Finally, the total average volume of halon released per year seems to indicate that only a minute percentage of existing halon is ever actually used - on the order of less than 2%. This is the figure as averaged over several years. In the two or three most recent years, however, the figure is much less than 1%.

THE FUTURE

Due to the inevitability that Halon 1301 will no longer be available at some point in time, an alternative "magic gas" must be developed that will possess characteristics similar to Halon 1301, but not have the perceived environmental downside.

The priorities for the two most important characteristics of an alternative gas include, in the order of importance, are 1) acceptable toxicological impact to people, since it must be utilized in manned facilities, and 2) explosion prevention capability such that it will inert the atmosphere and not support an overpressure situation.

In addition to supporting alternative testing, there is alternative design prospects being considered which could reduce the necessary stored volumes of Halon 1301 by identifying opportunities to modify facility layout and utilizing a more efficient fire zone logic system for voting where halon must be utilized. This is all being looked at, but in no case will the standard of care for human protection be lowered.