Additional Potential Contamination Events and Sources from Oil and Gas Development

Most of the major spill events for the oil and gas fields are described in the previous sections (also see Frates 1999b in Appendix A). However, during background investigations for this report, additional potential contamination events and sources were discovered in the KNWR Annual Narratives. It is likely that this is the first time the narratives have been reviewed comprehensively from a contaminants standpoint. Given the fact that the contaminant consequences of some of the explosions, spills, etc., on the oil/gas fields were not discovered until sometimes decades after the actual event occurred, it is crucial to document all known contamination events/potential events in this document.

The most poignant example of a contamination event that went undiscovered for several years was the SRF compressor plant explosion on January 26, 1972 (see pages 9-12). For fourteen years no one realized that this explosion released PCBs (Aroclor 1248). This unnoticed contamination event resulted in the spreading of PCB contaminated soils within SRF. The PCB cleanup lasted several years and is estimated to have cost over $40 million. It was only after a baseline survey of environmental contaminants on refuges with oil and gas development that this PCB contamination was discovered. This example highlights the importance of conducting baseline contaminants monitoring on refuges with potential contamination sources.

Over 1,000 soil samples were collected in association with the extensive PCB remediation efforts at Swanson River Field. USFWS Photo by Robert A. Richey.

The following sections contain information about potential contamination events and sources at the refuge related to oil/gas activities. The following topics are addressed: drilling muds and reserve pits, injection wells, explosions, fires, transformers, mercury manometers and seismic exploration.

Drilling Muds and Reserve Pits

The contamination potential of drilling muds has generated some controversy. At drill sites, typically unlined reserve pits served as storage for drilling muds, fluids, cuttings and produced waters. New regulations adopted by ADEC in 1996 require formal closure of inactive reserve pits (also known as monofills). According to Underwood (1998), "monofills are single-use waste disposal sites that are permitted with the intent of disposing of solid wastes which are not regulated under the Resource Conservation and Recovery Act (RCRA) as a hazardous waste" (page 1). According to the EPA's RCRA Orientation Manual (http://www.epa.gov/epaoswer/general/orientat/) under Subtitle C, "Certain wastes from the exploration and production of oil, gas, and geothermal energy are excluded from the definition of hazardous waste. These wastes include those that have been brought to the surface during oil and gas exploration and production operations, and other wastes that have come into contact with the oil and gas production stream (e.g., during removal of waters injected into the drill well to cool the drill bit)."

Historically, numerous unlined reserve pits were utilized as part of oil and gas development on the Kenai National Wildlife Refuge to store drilling muds, fluids, cuttings and produced waters.

Numerous unlined reserve pits were utilized historically on KNWR, all of which were backfilled and today are difficult to locate. In 1998, ADEC inspected 68 drill sites at SRF, where reserve pits would have been located. The ADEC concluded that no apparent contamination was associated with these sites. The ADEC issued formal closure of these sites in May 1999. In 1999, the ADEC inspected 6 drills sites at BCF, where reserve pits would have been located. As of May 2000, ADEC had approved Marathon's reserve pit closure plan, although final site closure is still pending. ADEC estimates that an additional 6-8 reserve pits are located outside the current operating unit boundaries (still within the refuge boundary); these pits have not received formal closure.

A USFWS study conducted by Rodney Jackson (1990) entitled, *Report of Findings: Kenai National Wildlife Refuge Drill Mud Pilot Study*, assessed the migration potential of drill mud pit materials to surrounding soils. Jackson discovered elevated trace metal concentrations in some samples, but concluded that overall there was no gross contamination. However, drill contents buried in reserve pits still may be a potential contamination source.

The September-December 1959 Annual Narrative offers a historical perspective about the uses of reserve pits and injection wells for drill mud and liquid waste disposal:

> *It appears as though the problem of waste disposal on the Kenai National Moose Range has been surmounted. The past season's cleanup operations indicate the following methods of waste disposal to be the best according to existing site conditions:*
>
> *1) In previously constructed waste sumps (reserve pits), long, deep, narrow pits were dug, using a dragline with a clam bucket. The "jell" (drill mud) was dozed into these pits, followed by a latticework layer of downed timber and brush. Then a layer of earth, three to four feet deep, was hauled in by "Turnapulls" to seal in the mud.*

> 2) *In new sump construction, the sump pits are either dug long and narrow or rectangular, according to topography. Along one side of the rectangular pits, an additional long and narrow excavation is dug below the bottom level of the sump to facilitate mud disposal during cleanup.*
>
> 3) *Liquid waste requires moving before disposal of waste mud can be accomplished. On the Moose Range, a dry hole (Well No. 3) was reopened October 20, 1959, to a depth of 3,200 feet. The casing was perforated 233 feet above this level and liquid waste injected at the rate of 4,000 barrels per day at 1,000 to 1,500 pounds pressure.*
> (pages 19-20)

Though reserve pits (now lined) are used less frequently today, they still are permitted and utilized in oil/gas operations on the refuge. In current operations, the majority of drilling wastes are injected underground into injection wells (discussed in the next section). Additionally, SRF and BCF each have a permitted facility for solid waste located on the refuge (page 50).

Injection Wells

Swanson River Field has five disposal wells and four enhanced recovery wells. Beaver Creek Field has two disposal wells.

As previously stated, lined reserve pits currently are used less frequently for storage of drilling muds, fluids, cuttings and produced waters. On KNWR, these substances usually are injected into 2,000+ feet deep disposal and/or enhanced recovery wells. SRF has five disposal wells and four enhanced recovery wells. BCF has two disposal wells. These wells are regulated by the Alaska Oil and Gas Conservation Commission (AOGCC) under the Underground Injection Control (UIC) program (20 AAC 25.252 and 20 AAC 25.402). Any well construction must be permitted by AOGCC. After construction, these wells are monitored regularly and tested for mechanical integrity every four years (yearly in SRF). According to the AOGCC, substances injected into enhanced recovery wells "must be appropriate for enhanced recovery and must function primarily to enhance recovery of oil and gas." These fluids include produced water, snowmelt, hydrotest fluids and treated effluent. According to AOGCC, substances injected into disposal wells must be associated with exploration and development of oil and gas and may include:

> 1) *any produced fluid as well as fluids circulated through a well as part of drilling, completion, workover, or maintenance activities; examples include muds and cuttings, produced sand and fluids, acids, frac fluids returned from downhole and well freeze protect fluids*
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> 2) *fluids that have come into contact with produced fluids during normal production operations; examples include freeze protect fluids, fluids in surface lines (prior to transportation), detergents or other media used to clean vessels and lines, scale inhibitors or other chemicals added to protect surface lines, spill cleanup material and rigwash*
>
> 3) *fluids necessary to facilitate disposal of produced fluids; examples include fresh or seawater, truck rinseates, new or*

used mud, or other additives used to slurrify or otherwise treat waste prior to injection

Because these wells are monitored and regulated, contamination issues resulting from injection practices likely are minimal. However, it is necessary to document this practice as a potential contamination issue.

Explosions

In addition to the SRF compressor plant explosion (pages 9-12), some other oil/gas exploration-related explosions have occurred on the refuge. Due to the seriousness of the compressor plant explosion and the resulting unforeseen contamination issues, other explosions also may have caused unnoticed contamination issues. The explosions listed in this section were documented in the Annual Narratives. It did not appear that these explosions prompted any sort of contaminant investigation.

According to the September-December 1960 Refuge Narrative, two major explosions occurred in 1960:

> *A section of the Alaska Natural Gas Pipeline Company's pipeline ruptured during pressure testing of the completed portion of their line early in the morning of November 17th. The break occurred near the Kenai Spur Road between Soldotna and Kenai. A low, overcast sky reflected the resulting fire, lighting up the area for miles around as though it were day. The line was being tested at 1,000 pounds pressure when it gave way.*
>
> *The second explosion occurred the evening of November 26th at SRU Well 14-27 [at SRF]. During drilling operations, a pocket of gas was encountered which seeped into the drilling building before the blow-out valve was closed. The accumulated gas within the building ignited, blowing out portions of the walls and roofing. Three men were injured requiring evacuation to Anchorage.* (page 19)

Another explosion occurred on March 11, 1981 at SRF. It happened in the emergency generator/boiler room causing extensive damage to the building including electric power and alarm/shut-down systems for Plant 10 compressors.

Fires

Substances considered to be relatively innocuous in the absence of heat may chemically transform during explosions and fires into hazardous chemicals (e.g., PAHs, dioxins/furans).

Fires can cause contamination in a variety of ways. Fires can diminish the integrity of pipes, tanks, and other containment vessels, releasing substances stored within them. Also, substances considered to be relatively innocuous in the absence of heat may chemically transform in the presence of heat into hazardous substances (e.g., PAHs, dioxins/furans). The fires listed in this section were noted in the Annual Narratives. It did not appear that these fires prompted any sort of contaminant investigation.

On March 4, 1962 at SRF, a fire occurred at the SCU 41-4 tank setting causing about $2000.00 loss to dehydration equipment.

On May 27, 1965, the exhaust pipe of a large gas compressor caught fire on SRF. Damage to the building amounted to several thousand dollars.

On July 29 1968 at SRF, refuge staff discovered an unreported fire that burned nearly an acre at Soldotna Creek well site 14-9. Another inspection of SRF on August 15, 1968, located two large unreported oil spills and two unreported fires.

On December 4, 1977 at SRF, a 5,000 bbl water-holding tank collapsed due to corrosion. This incident caused a chain-reaction, which burned and destroyed three 1-33 tank setting buildings and four other tanks. In 1982, the rebuilding of the 1-33 tank setting facilities was completed. Because the 1977 Annual Narrative could not be located, further information on this explosion is not readily available.

By the late 1980s all of the PCB-containing transformers at Swanson River Field were replaced, so they no longer contained PCBs.

Transformers

Residual contamination from PCB-containing transformers may be an issue at SRF (PCB-containing transformers were not used at BCF).

At Swanson River Field on September 15, 1981, a routine inspection of field transformers revealed a transformer crack that caused about two gallons of transformer oil to leak onto the ground. The oil contained 55 ppm PCBs. The oil remaining in the transformer was drained, and the crack was repaired. Oil from a second similar transformer also was drained and replaced. The supporting concrete pad was chipped away, and the gravel was removed. All contaminated material including work clothes, tools and the oil were drummed in 19 containers and shipped outside Alaska for proper disposal. The total cost of this cleanup to the operator was $54,000.

By the late 1980s all of the PCB-containing transformers at SRF were replaced, so they no longer contained PCBs. However, residual contamination may be an issue, if any transformer oil leaked before replacement occurred.

Mercury Manometers

Residual mercury contamination from mercury manometers may be an issue at SRF (mercury manometers were not used at BCF). Manometers are instruments used to measure pressure. For general information about mercury toxicity, please see Appendix E.

As of January 2, 1991 there were 18 active and one out-of-service manometers at SRF. The manometer locations, whether or not mercury contamination was detected and the amount of mercury that was in use at each location are presented in Appendix F.
A letter by Randall B. Kanady, Cook Inlet Environmental Coordinator, to the BLM on January 2, 1991 describes the use of each manometer at SRF:

> *Manometers No. 1-15 are used to monitor compressor engine scavenger air pressure. Manometer 16 is attached to a portable control panel that is used to monitor compressor engine scavenger*

air pressure, if there is a problem with one of the first fifteen manometers. Manometer 17 is used to calibrate non-mercury flow meters. Manometer 18 is used as a level monitor on the wastewater tank at the 1-33 tank setting. Manometer 19 is an out-of-surface calibration unit stored at the electric shop.

According to this letter, minor amounts of spilled mercury were discovered at eleven manometer locations (Appendix F). As of December 12, 1990 most of the mercury was recovered. During the first quarter of 1991 all mercury manometers, except manometer 17, were replaced with non-mercury gauges at SRF. However, residual mercury contamination still may be an issue.

Seismic Exploration
Seismic exploration for detecting oil formations has been conducted over large areas of the refuge, and the refuge maintains files and reports describing the areas where seismic exploration has occurred. Seismic mapping is typically conducted by using explosives. Explosive detonations send shock waves through the rock strata, and sound waves are reflected back to the surface. These sound waves are then detected, recorded and used with geological information to determine likely oil formation locations. Seismic exploration presents more of a habitat degradation/disturbance and wildlife disturbance issue than an apparent contamination issue. However, considering the extensiveness of seismic exploration on the refuge, these operations should be noted. One issue with seismic exploration is the potential for undetonated explosive charges. On September 20, 1993, an undetonated explosive charge was discovered by a hunter along the eastern border of SRF. The charge remained from seismic explorations conducted by Northern Geophysical Company in the winter of 1989-1990.

Summary: Additional Potential Contamination Events and Sources from Oil and Gas Development

Drilling muds and reserve pits, injection wells, explosions, fires, use of PCB-containing transformers, use of mercury manometers and seismic exploration activities are examples of some historic events and past (and current) practices which may have caused some unnoticed contamination issues on the refuge. The contamination potential of these incidents should be considered and contaminants sampling should be pursued if warranted.