

APPLYING SCIENCE AT ALYESKA: THE GOOD, THE BAD AND THE UGLY

Ott, Fredericka S. (Cordova District Fishermen United, Box 1271, Cordova, AK 99574) Presented at the American Fisheries Society National Meeting, September 5-8, 1989, Egan Convention Center, Anchorage, Alaska

INTRODUCTION

The Sunday editorial in the August 20, 1989, Anchorage Daily News caught my eye. It started with: "When an industry is pressed to defend its environmental record, the response often follows a familiar pattern. First, the industry argues there's no proof its activities cause any harm. As that evidence comes in, defenders say there's not enough and insist on more study. When those studies bring bad news, the industry can blame any damage on mistakes from the distant past."

To my surprise, rather than referring to the oil industry, the editorial went on to discuss the debate over statewide logging practices, a debate rekindled by a series of fish kills in logged streams in southeast Alaska. But the editorial could just as easily have been about the debate over the environmental track record of Alyeska, the supertanker terminal in Port Valdez, AK, and the focus of my talk today.

The common denominator in both these industries is the industry scientist or scientific consultant. Using Alyeska as an example, I will address two questions:

- 1) Is there a professional ethics problem among scientists who work for or at Alyeska?
- 2) How can industrial science be controlled so results are consistently useful to regulatory agencies and the public? (i.e., how do we know when to trust industry science?)

ALYESKA BACKGROUND INFORMATION

Currently about 25% of the United States' domestic oil comes from Alaska's North Slope operations. The North Slope crude flows through the 800 mile Trans Alaska Pipeline System (TAPS) to the Alyeska tanker terminal in Port Valdez, Alaska, where the crude is loaded into tankers and transported, primarily, south.

Summer 1977

Besides being a tanker terminal, Alyeska operates the largest ballast water treatment terminal in the United States. This facility has been operating for nearly 15 years. During this time, Alyeska has routinely discharged petroleum hydrocarbons into the air and water under discharge permits authorized, certified, and/or regulated by the U.S. Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC).

The Alyeska terminal was designed as a model facility but problems arose when actual plant construction and operation veered away from the original design approved by Congress. Originally the plant was designed in three phases, each phase involved a physical increase in plant size corresponding to an increase in pipeline throughput (Ott 1988, 1989).

Don't know

Today, however, the plant is the exact same size as when it was built in 1975 despite over a four fold increase in pipeline throughput since startup. Alyeska is currently operating in Phase III oil production (over 20 million barrels per day) with only a little over Phase I plant capacity: 3 ballast water storage tanks instead of the 5 approved by Congress; 18 crude oil holding tanks instead of the approved 32; and 3 vapor incinerators instead of the approved 4.

In addition, several key components for the ballast water treatment and pollution control systems either are not working properly or are simply missing from the present facility. Examples abound: the approved sludge incinerator and system for continuously monitoring effluent water quality were never built; the heaters to help separate oil from water were dismantled; the surface and bottom skimmers in the dissolved aeration flotation cells were removed as were the sulphur scrubbers in the vapor recovery system; miles of mild steel pipeline (part of the vapor recovery system) are corroding allowing toxic vapors to escape into the atmosphere.

Alyeska is currently operating under a very outdated 1980 NPDES permit. Despite liberal standards and availability of improved waste water treatment systems, multiple permit violations have been documented during the decade in which this permit has been in effect (GAD 1987, Lawn 1988). The EPA, supported by ADEC, has requested that the levels of aromatic hydrocarbons (benzene, ethylbenzene, toluene and xylene - BETX) in the effluent be reduced by as much as 95% in a new NPDES permit which Alyeska is currently stalling in the courts. While the new NPDES permit is tied up in legal processes, to-date a period of just over one year, Alyeska continues to

discharge higher levels of hydrocarbons into the environment than the regulatory agencies consider acceptable.

Alyeska's track record for compliance with state and federal air quality permits is just as abysmal. Alyeska records show that between 1980-1987, the vapor recovery system was fully operational 6.2% of the time and shut down 21.4% of the time or an average of more than one day in five (Anchorage Times, April 7, 1988:E-1). Introduction of natural gas liquids (NGLs) into the pipeline in December 1987 further stressed a system already rife with problems. Tanker emissions during the loading process, estimated as high as 1,000 tons of hydrocarbons a week, add to the total problem.

How are the oil companies getting away with all this? Let's begin by examining some of the scientific studies conducted at Alyeska to answer the question: is there a professional ethics problem among scientists who have done studies for or at Alyeska?

Professional Ethics and Science at Alyeska

In 1977, shortly after startup of operations at terminal, through 1981 two separate studies were conducted to determine actual versus theoretical effectiveness of dispersing the effluent plume as required by the first NPDES permit. These studies were to verify the theoretically-based boundaries of the mixing zone, a volume of receiving water required by state law to be as small as practical in which water quality criteria are waived for the purposes of dilution of the effluent.

One study was conducted by the Institute of Marine Science (IMS), University of Alaska, Fairbanks, under contract to Alyeska (Cifonelli 1979) while the second was conducted by Rockwell International under contract to EPA (Lysyj et al. 1981; Lysyj 1982). Results from both studies were in agreement: computer predictions of dilution rates were not supported by field data which indicated that a much greater volume of water was necessary to dilute the effluent plume under the permit limits. In other words, there were extensive permit violations.

Rockwell International studies also developed methodology to measure aromatic hydrocarbons in the water column (Lysyj et al. 1980, 1981) and then, utilizing this methodology, discovered that toxic aromatic hydrocarbons were being discharged into Port Valdez as a result of the continuous discharge of effluent from the Alyeska terminal (Lysyj 1982)

The second NPDES permit, issued in 1980, addressed these findings by: 1) establishing limits on the discharge of aromatic hydrocarbons; 2) requiring industry to produce methodology to reduce or eliminate these compounds in the effluent, and; 3) substantially increasing the boundaries of the mixing zone so Alyeska could operate legally

Two studies were contracted by Alyeska to verify compliance with water quality standards, one to Radian Corporation (Hoban et al. 1981) in 1981 and the other to Woodward-Clyde Consultants (1986, 1987) in 1985-1986. The Woodward-Clyde study was part of a larger study designed to determine whether BETX could be degraded biologically under the in situ (i.e., sub-arctic) conditions and was initiated after EPA began investigating the issue of sludge -- or, rather, lack of sludge. P
←

At any rate, both the Radian Corporation and the Woodward-Clyde studies invoked substantial and severe criticism. Questions about the findings of the Radian Corporation study were raised by Lysyj at Rockwell International in a 1982 correspondence with ADEC (Lysyj 1982b) and again by Belden Environmental Management, Inc. in 1988 whom ADEC contracted to perform an external audit of the state's files on Alyeska. The peer review found that the various BETX compounds were reported in vastly different proportions in the receiving waters than were known to occur in the effluent and concentrations did not correspond to known locations of the stratified diffuser plume (trap zone) casting doubt on the sampling procedures.

To make matters worse, data presented in the Radian report directly contradicted conclusions in the cover letter written by Alyeska (Lysyj 1982b). Alyeska's conclusions ranged from blatant contradictions of the data to misleading interpretations drawn from selective data. Contradictory and misleading interpretation of scientific data was to become a habit with Alyeska.

The infamous "Dye Tracer Study" and "Bench Scale Study" by Woodward-Clyde Consultants (1986, 1987) are classic examples of bad science with full collaboration from Alyeska. The dye tracer study was fraught with systemic errors resulting from procedural and equipment deficiencies. While the major errors were recognized by the authors, only some of the erroneous data were invalidated, such as the dye concentrations in the top 5 m because of the sensitivity of the fluorometer to ambient light (Belden Environmental Management, Inc. 1988).

The resulting data biases introduced by systemic errors were fully addressed in a ADEC review (Lawn 1988) which took over 500 man-hours to complete. A large volume of erroneous data was salvaged by applying a correction factor. Corrected data revealed 505% more "apparent and probable violations" than reported by Woodward-Clyde Consultants. ADEC also noted the poor quality of the data due to insufficient information, data gaps, unexplained data adjustments and deviations from the originally proposed work plan, and lack of data on compliance of the bottom of the mixing zone.

My favorite example of "deviate data" occurred when maximum dye concentrations were "smoothed to eliminate spikiness" (I.C.3.c. Woodward-Clyde Consultants 1986). There was no mention of the mathematical formula involved, but it is interesting to note that the difference between using the "smoothed" dye concentrations and the peak concentrations was usually the difference between a non-violation and a violation.

Alyeska for their part used this study as proof that their new biological treatment system was the long-awaited technology required by EPA to reduce BETX in the effluent. The decision by Alyeska (and EPA) to use a biological treatment system was itself the product of marginal science. In the words of Professor Mark Benjamin who was hired to review the bench scale study by the state attorney general:

"(The study) was not conducted with the care, forethought, or quality control which, to provide a benchmark, would be required of a student conducting the investigation as part of a Master's degree program" (Benjamin 1988).

Balden Environmental Management, Inc. (1988) was equally scathing in its comments:

"There are many technology options available for treatment of toxic and conventional pollutants in Sub-Arctic environment. Of those that were considered under NPDES renewal proceedings, biological treatment was found to be the least suitable to Valdez environmental conditions on technical grounds by both EPA and Alyeska's expert consultants (Sohio 1980; Sohio 1981; Science Applications International Corporation 1987)."

Is it an accident that Woodward-Clyde Consultants is not included among the references to Alyeska's expert consultants?

According to the experts, the biological treatment system at Alyeska "defies the laws of physics" in the words of Dr. Button (1987, undated), an eminent microbiologist of the IMS, Fairbanks, because the temperature is too cold (especially in winter), the residence time too short, the volume of the impound basins too small, the flow rate through the basins too fast, the flow rate into the basins too variable (no steady state conditions), the salinity of the ballast water too high and/or too variable, and, perhaps most notably - the system produces NO SLUDGE. (Biological treatment systems produce, typically, large quantities of sludge.)

Why did Alyeska conclude that a biological treatment system would work at the terminal? Because Woodward-Clyde Consultants misapplied the methodology to measure BETX developed by Lysyj and co-workers in 1980 (Balden Environmental Management, Inc. 1988). By using too large a sample size (10 liter versus 0.7-1 liter as specified by Lysyj et. al.), the load of BETX on the adsorption tube exceeded the tube's adsorption capacity, resulting in a large mass of BETX being lost to the atmosphere during the sparging process. Woodward-Clyde Consultants incorrectly attributed the mass of BETX lost to the atmosphere to biochemical removal.

It was later determined during an audit that Alyeska also misapplied the procedure developed by Lysyj (1982) for monitoring the discharge from the ballast water treatment plant for BETX content. This procedure was designed for on-site analysis using unpreserved water samples to be analyzed within 2 hr after collection. Alyeska sent unpreserved water samples south for analysis - the hydrocarbons evaporated - which resulted in understated incorrect results and led to erroneous conclusions regarding compliance with water quality standards (Balden Environmental Management, Inc. 1988).

Alyeska's unethical practices are not limited to operational monitoring. Results from an environmental study in Port Valdez conducted by IMS, Fairbanks under contract to Alyeska were summarized by Alyeska to show "the water quality of Port Valdez has been virtually unaffected" by terminal operations" (Anchorage Daily News, July 29, 1989:A-1). Meanwhile, one of the report's authors (Feder) stated: "It will never be possible to assess changes that occurred in (one area near the outfall) since the oil terminal became operational" because EPA changed the sampling points for the study (Shaw and Feder 1988).

When ADEC reviewed the IMS environmental report, it found several problems with methodology, statistical analyses and quality control (Howe 1988). For example, the sediment chemistry section includes NO statistical

analysis of the data; instead conclusions are based on visual examination - EYEBALLING - of the data tables! ADEC further found that the data did show some significant findings that were not presented in the executive summary or conclusions, such as petroleum hydrocarbon contamination was more widespread than in previous years as it was present in ALL sediments sampled in Port Valdez in 1987 and, further, that this contamination was highest near the diffuser outfall. ADEC concluded that: "(these problems) cast serious doubt on several of the conclusions reached in the reports or reported to the media by Alyeska" (Howe 1988).

I think it is fairly obvious from this account that there is some very unethical science being conducted by certain individuals and firms under contract to Alyeska. It should also be obvious from the few examples presented that certain Alyeska officials are themselves not above unethical behavior. What to do?

Solutions Part I:
Defining the Good, the Bad and the Ugly

Before we can discuss solutions to controlling unethical behavior, let's better define the problem. The studies and examples presented fall into three categories:

- 1) the Good examples, in which results of studies contracted by Alyeska are in agreement with results of independent studies (eg, Colonel 1979 & Lysyj et. al. 1981, Lysyj 1982);
- 2) the Bad examples, in which results of studies contracted by Alyeska disagree with or contradict results of independent studies (eg, Hoban et. al. 1981, Woodward-Clyde Consultants 1986, 1987 & Lysyj et. al. 1980, Lysyj 1982).

In the Bad examples, regulatory agencies must judge which studies to believe. This puts the regulatory agencies in an ethical dilemma because they must make a judgement call. This further divides the studies into a third category:

- 3) the Ugly examples, in which regulatory agencies, for whatever reason, make a bad judgement call thus further encouraging unethical science

Unfortunately, varying degrees of Ugly examples abound at Alyeska. The first example involves EPA's decision to expand the mixing zone to accomo-

Who's
?

date dispersal of Alyeska's effluent and issue the second (1900) NPDES permit. This decision actually wasn't so bad given the fact that hydrocarbon monitoring technology was in its infancy. However, EPA did make a bad call when the NPDES permit expired in 1983: it allowed Alyeska to continue operating. This move provided Alyeska with zero incentive to develop the required methodology to reduce BETX in the effluent. In fact, Alyeska is still operating under the 1980 NPDES permit. ??

Another Ugly example occurred when EPA allowed Alyeska to install a biological treatment system. When EPA decided this, not only did they condone the Woodward-Clyde Consultants studies, which to reiterate, are extremely poor science, but EPA also swallowed Alyeska's economic rationale for choosing the biological treatment system above the three more technologically advanced (and more expensive) alternatives; that is EPA classified Alyeska as a non-profit organization! One only has to read Alyeska's financial disclosure to determine that Alyeska has made more than \$12 billion profit for its owners since startup.

A third, final, and really Ugly example occurred in conjunction with the external independent audits of the state's Alyeska files by the ADEC and Attorney General. Although both audits agreed and confirmed that some studies contracted by Alyeska, specifically the Woodward-Clyde studies, were unreliable because of errors, inconsistencies, ambiguities and poor quality control, the state has taken no action against Alyeska or its consultants as a result of the audits. Further, a state investigator basically absolved the consulting firm and Alyeska by stating that the reports were found to be "basically sound" in direct contradiction to the results of both audits! (Anchorage Daily News, June 27, 1988:B-1) who did this

As an aside, I must note at this point that although North Slope operations generate 85% of the state's revenue and although Alyeska operates the largest ballast water treatment plant in the United States, the state has provided for only one half-time position to monitor Alyeska . . . you may make your own ethical judgement call.

To be fair to the regulatory agencies, several factors may contribute to their seemingly inappropriate behavior. Partly at fault is the EPA permitting process itself. EPA writes generic permits for industries grouped by size and type. For a specific industry, EPA then tailors the appropriate generic permit based on, usually, its choice of numerous scientific studies. However, Alyeska, because of its size, is in a class of its own. EPA has no prior experience to fall back on and must, therefore, rely on studies provided by

Alyeska or contract its own. The agencies cite budget cuts, lack of staff and too many other responsibilities to explain why they have had to largely rely on Alyeska to provide its own compliance data since 1982.

How can the Bad and the Ugly situations be corrected?

Solutions Part II:

What to Do About the Good, the Bad and the Ugly

What has been tried at Alyeska? External audits, for one. The problems with external audits as utilized by the state are that this was an extreme measure taken after the science was already suspect and then no action was taken despite findings of inappropriate science. If external audits are to be effective tool for regulatory agencies, I suggest independent audits be used regularly just prior to renewal of major (NPDES) permits and the audit results should be taken seriously by the agencies. Cost of the audits should be borne by industry as a cost of doing business.

Regulating industry by Congressional decree has also been tried at Alyeska without much success. In the Trans-Alaska Pipeline System right-of-way agreement between the United States and the seven oil companies who own Alyeska, Congress stipulated that the waste water treatment facility would be reviewed at least once every five years primarily to consider the feasibility of improving plant performance through advances in water pollution control technology (U.S. Congress Sec. 23.C). Yet in nearly 13 years of operation, the terminal has never been reviewed or upgraded. Congressional hearings on Alyeska operations are pending, but, like the external audit, the hearings come after there is a problem. In my opinion Congressional decree should not be relied upon to regulate industry because there is no guarantee that the stipulations will be carried out in a timely manner.

Public pressure has been tried at Alyeska, but not citizen's involvement until very recently (post oil spill). Involvement by Cordova District Fishermen United and Charles Harnel, a Virginia oil broker, in the Alyeska controversy (are they or are they not polluting?) have been covered extensively for years by Anchorage Daily News reporter Patti Epler. One of the fishermen's requests has been for an active citizen's oversight and monitoring committee such as exists at the tanker terminal in Sullom Voe, Scotland, a sister terminal to Alyeska. Such a committee is provided for under state statute. However, it took an 11 million gallon oil spill to pressure the oil industry into establishing a citizen's advisory committee - and the present committee falls far short of citizen's requests, although it is a beginning.

Ideally, the citizen's advisory committee will serve essentially as internal auditors. Depending on committee composition, the group could either review or contract scientists to review studies proposed and conducted by the oil industry. The committee would then make public recommendations to regulatory agencies based on results of its reviews. Internal reviews such as this would, in theory, not only discourage unethical science from being conducted in the first place, but could also be responsive enough to correct unethical situations immediately. In my opinion, internal audit systems, whether composed of citizens or scientists, are the answer to both discouraging and correcting unethical science.

Where does that leave us with Alyeska? To get back to the Sunday Anchorage Daily News editorial (August 20, 1989): "When money conflicts with protecting nature, those with the money too often get the benefit of the doubt . . . Only when nature starts to reel from abuse do we start to reconsider. By then the harm is done. Repairing the damage usually costs more than prevention would have - if it can be fixed at all."

We need to fix the problems of Alyeska before we create another Superfund site. We need a comprehensive audit of the entire facility. (Preferably, Dr. Lysyj, who is renown and active in his field, could conduct the audit on the waste water treatment system.) We need an active citizen's advisory committee that is capable of performing internal scientific audits.

What we have at Alyeska is an attitude problem. I call it the Cool Hand Luke Syndrome. The technology exists to truly reduce - and even eliminate - the discharge of toxic hydrocarbons into the water and air, but the industry refuses to utilize it. It's business as usual at Alyeska. Their track record from the past reflects the way they currently conduct business and the way they plan to conduct business in the future. It is time to correct their attitude - and the way they do business. I appeal to the scientific community for help.

LITERATURE CITED

- Balden Environmental Management, Inc. 1988. Review and analysis of ADEC departmental files dealing with Alyeska and NPDES permit. 41 pp. ADEC FILES.
- Benjamin, M.M. 1988. Responses of Mark Benjamin to questions posed by Mary Pinkel, assistant attorney general of the state of Alaska. April 17, 1988. 9 pp. ADEC FILES.
- Button, D.K. 1987. D.K. Button comments draft NPDES permit. ADEC FILES.
- Button, D.K. Undated. Alyeska (Woodward-Clyde) Final Report, September 1986. Institute of Marine Science, University of Alaska, Fairbanks.
- Colonell, J.M. 1979. Ballast water dispersal: Continuing environmental studies of Port Valdez, Alaska 1976-1979. IMS Report No. R79-2. University of Alaska, Fairbanks.
- GAO. 1987. United States General Accounting Office: "Water Pollution, EPA Controls over Ballast Water at Trans-Alaska Pipeline Marine Terminal." Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives. GAO/RCEO-87-118, June 1987.
- Hoben, M.A., R.C. Hanish and G.M. Crawford. 1981. Alyeska ballast water diffuser verification study and survey of lead and selenium in tissues and sediments from Port Valdez, Alaska. Radian Corporation, Austin, Texas.
- Howe, J. 1988. Alyeska Pipeline Service Co. IMS Report. ADEC memorandum. October 31, 1988. 5 pp.
- Lawn, D.J. 1988. ADEC Review of Alyeska's Data Report, March 1986. Alaska Department of Environmental Conservation, Juneau, Alaska.
- Lysyj, I., G. Perkins and J.S. Farlow. 1980. Trace analysis for aromatic hydrocarbons in natural waters. Environ. International Vol 4: 407-417
- Lysyj, I., G. Perkins, J.S. Farlow and R.W. Morris. 1981. Distribution of aromatic hydrocarbons in Port Valdez, Alaska. 1981 Oil Spill Conference, American Petroleum Institute Publication No. 4334, API, Washington, D.C.

- Lysyj, I. 1982a. Treatment of oily wastewaters from onshore operations. J Water Poll. Control Feder. March. Pp. 309-315.
- Lysyj, I. 1982b. Letter to Bill Lamoreaux regarding Alyeska NPDES review. ADEC FILES: February 11, 1982.
- Ott, F.S. 1988. Cordova District Fishermen United's comments on draft Alyeska NPDES permit. 33 pp. ADEC FILES.
- Ott, F.S. 1989. Testimony before the U.S. House Interior Committee. May 7, 1989. 33 pp.
- Science Applications International Corporation. 1987. In Balden Environmental Management, Inc. 1988.
- Sohio. 1980. Toxic and conventional waste treatment and disposal study: literature search and process investigations. Sohio Research and Development Department, Cleveland, Ohio. December 20, 1980.
- Sohio. 1981. "Toxic and conventional waste treatment and disposal study: engineering development analysis" by R.B. Stalzer and D.R. Marrs. Sohio Research and Development Department, Cleveland, Ohio. December 1981.
- United States Congress. 1973. Agreement and Grant of Right-of-Way for Trans-Alaska Pipeline between the United States of America and Amersada Hess Corporation, ARCO Pipe Line Company, Exxon Pipeline Company, Mobil Alaska Pipeline Company, Phillips Petroleum Company, Sohio Pipe Line Company, and Union Alaska Pipeline Company.
- Woodward-Clyde Consultants. 1986a. Alyeska bench test for removal of aromatic hydrocarbons. Final Report. Woodward-Clyde Consultants, Anchorage, AK, 99503. September 1986.
- Woodward-Clyde Consultants. 1986b. Data Report: Port Valdez receiving water study, ballast water treatment facility. Prepared in association with Entrix, Inc., for Alyeska Pipeline Service Company. Two volumes: October 1985, March 1986.
- Woodward-Clyde Consultants. 1987. Ballast water treatment facility effluent plume behavior: A synthesis of findings. Woodward-Clyde Consultants, Anchorage, AK, 99503. March 1987.