CHAPTER V
Corps Dredge Operations

In addition to the overall problems of command and control and communication, the Corps of Engineers faced operational problems in the dredge oil recovery activities. Alaska District staff had difficulty providing logistical support to the dredges while they operated in remote areas of the Gulf of Alaska and Prince William Sound. Even more significant were the problems that the dredge crews faced in locating significant amounts of oil, collecting oil off the water, accurately measuring the amount of recovered oil, and removing the oil from the dredge hoppers.

Political sensitivities sometimes prevented the dredges from coming to port, so crew changes, VIP visits, and the delivery of supplies were conducted in unprotected waters via float plane, thus exposing Corps personnel to increased risks. Sudden relocations of the dredges forced Alaska District staff to devise logistical support plans for each resupply operation.

In normal operations, crews changed weekly with a complete rotation of the crew on the *Essayons* every Tuesday and on the *Yaquina* every Thursday. For the Alaska operation, however, the crews elected to work on a two-week rotation schedule (as they do in overseas operations) to minimize their transportation costs.

The first crew change in Alaska was one of the most innovative, challenging, and dramatic that the Corps had ever conducted. When the *Yaquina* arrived in Alaskan waters, the crew's two-week tour was ending and they were due for a change. Crew changes were normally done while a dredge was in port, but General McInerney ordered the dredge to bypass port and go directly to work.[1]

The decision to send the dredge directly to work was prompted by both operational requirements and public relations concerns. The surface oil was dissipating rapidly, and it was important to get the dredge into the field as quickly as possible. Moreover, it did not look good to have the dredge go all the way to Alaska and then go into port. On leaving Anchorage, John Elmore had instructed the District to "hit the beaches running." A Soviet skimmer had just arrived in Alaska and officials in HQUSACE and in the Pentagon were anxious that the Corps dredges reach the oil first. "There is no doubt that our mission was to get there before the Russians did," Colonel Kakel explained.[2]

Alaska District quickly developed new plans and procedures to conduct the crew change at sea. The replacement crew for the *Yaquina* arrived from Portland and went from the Anchorage airport to the District office where Colonel Kakel briefed them. The next morning they boarded a one-car train that the District had chartered for the 65-mile, three-hour trip to Whittier. There is no road from Anchorage to Whittier. In addition to the crew, the train carried provisions, baggage, District officials, and Charles Hummer. On 20 April two float planes, which Alaska District chartered out of Cordova, flew to Whittier and shuttled the crew back and forth to the dredge, which was working three hours away near Perry Island.

The process took most of the day because the float plane could ferry only four to six men at a time. Meanwhile, two fishing boats rented by District staff transported supplies to the dredge. Although not coming into port for the first crew change created what one official called a "logistical nightmare," it was also beneficial because the crew was in the process of developing a technique to recover the oil and its work could continue uninterrupted.[3]

Gradually a firm procedure for conducting crew changes evolved. Corps personnel first located a town where the dredge could connect with the new crew, and then got approval through the AK-JTF, Exxon, and the Coast Guard to let the dredge take half a day to run to one of these towns for a crew change. Initially Joint Task Force and Coast Guard officials resisted this interruption, but they came to understand the necessity. After that the only problems involved logistics and transportation.

The procedure varied only slightly depending on the location. Corps personnel used several towns for crew changes — Homer, Seward, and Whittier once. Alaska District rented a Greyhound bus to transport the crew to Seward. The bus waited while one crew went on board and exchanged information with the other, and then it returned to Anchorage with the old crew. The bus usually pulled into Anchorage about 7:00 P.M. and some of the crew flew out on the "red eye special." Others left the next day. When the crew change was in Homer, NPA chartered a plane to shuttle crews back and forth.

A major resupply occurred every two weeks with the crew change. Alaska District staff arranged for groceries and other supplies to be available on a certain date and then used the District's vans or a flatbed truck to run the supplies from Anchorage to the location of the crew change. Between crew changes, District staff sent emergency goods via float plane.[4]

Logistical support to the dredges in the oil spill operations was further complicated by changes in the command structure. Officially, the dredges were under the operational control of the Alaska Joint Task Force. As the engineering agency of the AK-JTF, Alaska District became responsible for supporting the dredges. Thus the established support relationship between the dredge and the owning District (Portland) was severed and replaced with a system unfamiliar to both organizations. Alaska District did not have the organization and staff necessary to handle the volume and variety of requirements for supporting the dredges. Nor did it have experience with this type of work. Moreover, the dredges changed location constantly. "The most significant revelation of this exercise," Alaska District staff conceded, "was that we did not have a well-thought-out plan on how to equip our dredges or keep them supplied during remote operations."[5] Although Portland District sent personnel to augment Alaska District's staff, the difficulties continued.

While Alaska District grappled with the problem of providing logistical support, the dredge crews struggled to locate and recover oil. By the time the dredges arrived on scene, the oil had dispersed throughout Prince William Sound and the Gulf of Alaska to such an extent that locating and containing it was a significant problem. Oil on the water was very difficult to spot from the surface. People on the fishing vessels and dredges had to be in the oil in order to see it.

Because of the vast distances and the difficulty in spotting oil from the surface, it was essential to employ aircraft that could fly at speeds low enough so spotters could distinguish oil from other floating debris. Yet there were never enough aircraft available, and low cloud cover and severe weather conditions often made aerial reconnaissance impossible. Also, the aircraft and the vessels they supported were often on different radio frequencies so that communications were impaired or nonexistent.

In early April, Exxon provided morning and evening overflights through Prince William Sound and along the slick past Seward to the leading edge of the spill. Exxon aircraft had infrared capability to verify the presence of the oil. A Coast Guard airplane also conducted overflights twice daily to track the movement of the slick down the coast. The *Essayons* had a helicopter pad, which it could have used to provide aerial reconnaissance, but it was not operational. The crew was not certified, nor did the dredge have the qualified personnel on board to operate the landing pad: helicopter officer, flight deck officer, landing officer, and mate on watch.[6] There was reluctance to bring in trained non-Corps personnel to man the pad.

Infrequent air support meant that the collection equipment was often in the wrong place. Dredge crews often hurried to locations only to find that the "oil" was not oil. They were frustrated by the days without oil recovery assignments. As the weeks passed it became increasingly difficult to find significant amounts of oil on the water surface.

After locating the oil, cleanup workers faced the problem of collecting this thick, sticky substance. The weathering of crude oil in cold climates involves a number of physical, chemical, and biological processes including evaporation, dissolution into the water, dispersion, and emulsification. In the first few days after oil is spilled, the lighter components of the oil rapidly evaporate, the volume of the spill decreases, and the physical and chemical properties of the oil change. The amount and rate of evaporation decreases with time as the lighter components diminish, leaving only the heavier, less volatile components. With Prudhoe Bay crude oil, approximately 23 percent of the content is a relatively light component (i.e., octanes, benzene) that evaporates quickly. Most of this component is gone within one to two days, and the evaporation process is essentially complete in five days.

In a high wave energy area, roughly twenty-four hours after an oil spill, depending on temperature and wave action, the oil and seawater emulsify, forming a highly viscous material called "mousse" that contains roughly 70 percent water and exhibits properties very different from the original oil. This very sticky material adheres to almost all objects it encounters (i.e., rocks, ships, birds, sea otters). Mousse developed during many major tanker spills, including the *Amoco Cadiz*. The time it takes for mousse to form is a function of the type of oil spilled. In the *Amoco Cadiz* spill, mousse formed quickly — soon after leaving the ship. Experience has shown that conventional spill response equipment is not very effective with mousse.[7]

The dredge crews developed two reasonably effective methods for collecting the surface oil. Either the crews used the dragheads and dredge pumps to suck up oil that smaller vessels had collected inside the booms, called "donuts," or they strung boom between the dredge and one or two support vessels and slowly sailed through the large concentration of oil, funneling the oil toward the dragheads to be drawn up. The best configuration was to have two booms, one on each side of the dredge with associated crafts. The vessel could theoretically make a swath of four hundred feet, perhaps more if workers attached additional boom. They were limited by the strength of the booms, their heights and stability with respect to speed, and the horsepower of the associated craft.

Towing the booms was a slow process. The booms contained many parts (air bags, metal struts, 36-inch facing, and nuts and bolts) that required a great deal of maintenance. Unlike simple containment boom that can be patched easily, these booms required special parts and trained personnel for repairs. Air-filled sacks held the booms upright; each sack had a square bag on the end to act as a weight that prevented the bag from going vertical. When towing, the air bags were perpendicular to the booms, and the combined resistance when towing fifty to sixty air bags "significantly slowed the boats."[8] In addition, the dredge could tow the heavy booms no faster than four knots or the booms would flip over. The dredge had difficulty going slow enough to work with smaller vessels in skimming operations. The *Yaquina* had no space to carry the booms on board, so the crew used the craft towing the booms to load each ninety-pound section, a few bags at a time, across its stern. They righted each bag manually. This arduous work required four people.

The crew quickly discovered that the 36-inch booms they brought were too small and flimsy to hold the oil in the choppy waters of Prince William Sound and the Gulf of Alaska. The 84-inch roll booms (Swedish booms) worked best. Booms with bridle around them did not work because the bridle would catch in the dragarm. The *Yaquina* crew contended that if they had been assigned the proper booms permanently, with a craft capable of maintaining them, they could have recovered 20 percent more oil.[9]

The thickness of the oil and the fact that it contained kelp and debris made the task more difficult. The original plan had been to pump oil out of small skimmers, but the actual work evolved differently. The centrifugal and concrete pumps that the dredges brought proved to be ineffective at loading the thick product.

In normal operations, dragheads are drawn across the channel bottom with the dredge pumps creating a vacuum which discharges a slurry mixture of sand and water into the dredge hopper. The hopper contents are later emptied through bottom gates or doors. The crews modified the dredges in order to recover oil. They inverted the dragheads and constructed a cage around the dragheads to prevent booms and debris from being sucked into the dragarm. The inverted draghead proved to be the best readily available configuration that did not require extensive structural modification. Bolt holes on the draghead did not match up in that configuration so the crew turned the dragarm 180 degrees at the swivel point in the center of the arm. This made it impossible to reconnect the dragarm wire, so the crew wrapped straps of heavy wire around the pipe and attached a shackle. Using this procedure, it was possible to maneuver the dragarm as usual.

After this technique proved successful, the crew refined it. The crew discovered that effective use of the new system required at least five people: a ship handler to control the vessel alongside the boom; a dragarm/pumpman to control vertical draghead position and pump speed; a hopper bin tender to insure that no overflow occurred; an on-site draghead coordinator; and boom skirt tenders to keep the boom from being sucked into the draghead, remove large debris, and help shift the flow of material into the draghead. The on-site coordinator, usually on the main deck, would have charge of the vessel's position only for boom operations. The ship handler retained overall control of vessel safety and traffic matters.[10]

The crew lowered the draghead into the water and then raised it to within a few feet of the surface and turned on the pumps to full capacity. Then the dragtender raised the head slowly until the oil moved into it. The proper placing of the draghead was the most critical part of the on-loading process. If the draghead came above the surface and pumped air, it lost prime; if it was too far below the surface, too much water went into the hopper.

The *Essayons* tended to work in open water with rougher seas while the smaller *Yaquina* operated in more protected areas. The *Essayons* started work at Gore Rock and moved as far north as Resurrection Bay and as far south as Sutwick Island in Shelikof Strait west of Kodiak Island, primarily along the Alaskan Peninsula. The *Yaquina* began work around Knight Island in Prince William Sound. As difficult as sucking oil into the dredges was in heavy seas, on 8 May the *Essayons* pulled in 200 barrels in five-foot waves. The *International Dredging Review* observed: "Corps dredge crew members are among the heros of the cleanup effort. They overcame the frustration of equipment that would not work and found a way to make it do the job. . . the Corps hopper dredges *Essayons* and *Yaquina*, along with the Russian dredge, are the most effective cleanup devices on the site, and their crews are doing an outstanding job."[11]

A Portland District photographer, Billy Johnson, boarded the *Essayons* to make a video of the dragarms in operation. The Alaska Oil Spill Multi-Agency Coordination group at Seward watched video footage of the *Essayons*' inverted draghead in operation, and after seeing the footage, some members of the group dubbed the dredge "mega-sucker." The video was flown to Washington where President Bush viewed it. Later United States Park Service spokesman John Quinley told the media that the Corps dredge "has proved to be one of the most effective machines" in the oil recovery operations. By 27 April the two dredges had collected 3,271 barrels of oil, representing 36 percent of the oil collected since their arrival. By 10 May they had collected 5,016 barrels.[12]

The *Yaquina* crew recommended a new design for the dragheads with smooth features rather than angular lines, oil boom preventers, consistent 360 degrees draw of material, and removable quick cleanout grates. They suggested using lightweight plastic for construction material.[13]

The Corps dredges were clearly the most successful oil recovery vessels in Alaska. The *Vaydaghubsky* was configured somewhat like the dredges, but it was equipped with its own boom which it deployed from its hull. A cross beam attached to the end of the boom allowed the vessel to hold its own boom rather than have fishing vessels pull it. The huge skimmer can create a catch width of sixty meters when the booms are fully extended. The oil accumulating inside the boom is transferred on board the vessel by two free-floating type FRAMO oil skimmers which collect an aggregate rating of 800 cubic meters an hour. Oil can be stored in the hopper or in four multipurpose tanks. Water settling from the recovered oil and water mixture is pumped back to the sea through a 300 cubic meter an hour separator that draws the remaining oil from the water before letting it overboard.[14]

Although the Soviet skimmer had been tested in the field, this was its first major oil spill. Initially Coast Guard and Exxon officials considered the costly Soviet skimmer the best hope for cleaning up oil on the high seas, but it did not meet those expectations. By the time it arrived, the oil had either dissipated or become too viscous for the skimmer to pick it up. The ship spent much of its time chasing small patches of oil in the Gulf of Alaska and in Shelikof Strait. Its pumps continued to choke on the thick, debris-laden oil, and cleanup officials appealed to the Corps. Late one night Colonel Kakel received a call from Captain Rainey at the Coast Guard Marine Safety Office in Valdez asking the Corps to help the skimmer. In response, the *Yaquina*'s captain offered the skimmer advice about on-loading techniques, and the skimmer made some modifications. The skimmer, however, was designed in such a way that operators could not unbolt the draghead and invert it as the dredges had done.[15]

In addition, the operations of the *Vaydaghubsky* were significantly curtailed by severe weather and the lack of aerial reconnaissance. The presence of the skimmer created some tension. There was a tendency to compare the performance of the Soviet skimmer with the Corps dredges even though the vessels functioned differently and had different opportunities for oil collection. White House, State Department, and Coast Guard officials were anxious that the skimmer be successful. Yet Colonel Kakel, his staff, and the dredge crews felt pressure from senior officials in the Pentagon and HQUSACE to perform better than the Russians. Although he was placed in an awkward position, Colonel Kakel continued to downplay the competitive aspect and to encourage his staff to function as "team players." Dredge crews felt that they were held back at times so that the Russians could collect oil, but Coast Guard officials denied this.[16]

After the dredge crews loaded the oil, they faced yet another problem: how to measure and report the amount of oil recovered accurately. The oil mixture contained a great deal of water and, as time passed, the oil and water in the hoppers separated and the amount off-loaded would be less than what was previously reported as stored in the hopper. The Corps calculated the oil off-loaded from the dredges by measuring the difference between oil in the hoppers before and after the oil transfer. Exxon, however, based its figures for off-loaded oil on the total liquid pumped into storage barges and did not include the debris and water with the oil. Dredge crews began letting the oil settle in the hoppers before measuring it to permit the oil and water to separate. Headquarters, however, pressured the crews to turn in barrel counts quickly before the oil and water mixture had had time enough to decant. Speculative figures became etched in stone. The crews simply tried to provide the most accurate figures possible.[17]

The crew based their initial calculations of oil spoils in the hoppers of the *Yaquina* on the assumptions that the oil had a consistent viscosity and that water separated from the spoils in a "reasonable" time. The crew developed special techniques for measuring the ever changing mixture in their hoppers. Initially the crew used a procedure that was much like putting a dip stick in the oil tank of a car. They measured the mixture in the hoppers by pushing a metal tape coated with water-sensing paste through the oil. This method failed because water in the spoils activated the tape prematurely.

The oil soon became too thick for the tape to penetrate, so the crew began to lower a weight into the hopper to determine the boundary between the oil and water layers. This method was not very effective because the densities were not consistent and separation did not occur within a reasonable time. The crew discovered that the material was hardening not only on the surface layer, which was expected, but throughout the mixture. Results of additional tests and new measurements confirmed that the oil and water were still separating and the mixture was hardening and condensing in volume over time. They also confirmed that earlier measurements were inaccurate because they did not allow enough time for the oil and water to separate.

Captain Jimenez observed that to get an accurate measurement, operators must use a consistent methodology and give the material enough time to separate. Also, the larger the volume of spoils, the faster that volume will shrink; the longer the spoils are left in the hopper, the harder it will be to remove them. Jimenez recommended that the material be left in the hopper no longer than forty-eight hours and be agitated or broken up occasionally to prevent block solidification, and that water be introduced into the spoils before discharging. Also, by lowering the spoils below the center line separator, the product was forced to flow and break up. Water should be added at this time.[18]

After the oil in the hopper was measured, there were problems and discrepancies in reporting the quantities of skimmed oil. Initially, quantities of oil were reported at different times of the day because reporting times differed for various chains of command. This problem was later resolved by establishing a standard time (3:00 P.M.) for all reporting. The Corps itself had problems coming up with accurate figures. For example, on 28 and 29 April there were large discrepancies in the amount of oil product reported as remaining in the hopper. On 28 April the *Yaquina* reported 805 barrels and on the 29th it reported 53 barrels. Investigation revealed that the *Yaquina* and the Alaska District EOC were using different methods to account for the oil product remaining in the hopper at the end of each reporting period. The problem was eliminated by modifying the EOC system to conform to the *Yaquina* system.[19]

The *Yaquina* crew recommended the development of a daily form for reporting which included reporting time, total amount of product carried, vessel location, vessels on-loading and off-loading, and amount discharged. They also suggested that reporting be done in the evening prior to off-loading.[20]

Even more challenging than loading and measuring the oil was the task of removing the oil from the dredge hoppers. The process of off-loading the heavy oil mixed with seaweed, kelp, and debris in both Prince William Sound and western Alaska was slow and difficult. The plan was to pump the collected oil from the dredge hoppers into Exxon barges. Over time, however, the weathered oil in the hopper changed from a viscous liquid to a substance the consistency of tar, axle grease, or asphalt.

Operators in Alaska tried using various pumping systems to move the mixture: Super Vac (a vane driven air mover designed to move grain and modified for this operation), Super Sucker (a high volume air conveyor), Hyde-Vac (an air mover used in moving fish), archimedes screw-driven pumps (includes GT-185, DESMI 250, DESMI 250A), and the Vac-All (both truck and portable units similar to Super Sucker but with lower volume). The systems that Exxon provided worked but they were very slow because of the thickness and debris in the oil. For example, in an eight-hour period the Hyde-Vac pumped about 4,200 gallons (or 100 barrels) of oil out of the *Yaquina*'s 180,000-gallon hopper. Dredge crews simply did not have the right equipment for off-loading the viscous mixture.

Captain Jimenez and his crew eventually discovered that the Vac-U-Vator, a system sometimes used to throw chips on sawdust piles, was the most effective pump for discharging the oil mixture. Initially no one knew how to use it, so they had to rely on the Super Vac, a truck type system used to vacuum out sewage tanks. Super Vac's biggest drawback was its discharge rate. The truck filled quickly, and the crew had to stop operations to empty it. The truck's contents were discharged from an opening in back through a hose into a hole in the barge. The opening would clog with oil, thus slowing the discharge rate. The *Yaquina* crew increased the discharge rate 20 percent by constructing a large rectangular box around the hatch opening that allowed the truck to open its back and, like a dump truck, empty its load quickly. Exxon adopted the same technique on other barges. The Vac-U-Vator was a smaller machine, half the size of the Super Vac truck, but it functioned constantly so the crew never had to stop. Also, it did not require a source of air because it brought air from the outside. It required a 50/50 mixture of air/material. The system broke down because of mechanical failure.

Submersible pumps did not have enough power to handle the thick mousse. The worm types developed by Destoil were very powerful. They could chew up the debris in the oil, but their pulse volume was too short. The product moved too slowly into the cavities so water quickly bypassed the product. As a result, the crew had to float the pump at a critical water boundary layer, which was difficult. Another problem was that both Vac-U-Vator and Super Vac require that the crew remove the deck grating and insert a 10-inch or 12-inch hose down into the product. With the machines on, the hose ends "danced" because of the powerful vacuum forces. Too deep into the product and the hoses drew water, too high and they drew air.

The thick mixture clogged the pumps and would not flow toward the vacuum draw. Several pumps proved unsuccessful, including diaphragm pumps and submersible pumps, both of 3-inch hose diameter. Other pumps proved more successful, specifically air vacuum pumps, where the suction could be moved around the product surface, and worm pumps that could be submerged and their surface height varied.[21]

Portland District staff had anticipated problems removing the oil. They knew that the crude oil would be "chunky" and that because of the cold water it would congeal. Therefore they had equipped the dredges with special steam coils to heat the oil, but the coils were not very effective, in part because the dredge hoppers were too exposed on top. Heated coils were usually put into enclosed barges. The dredge boilers were not powerful enough to supply the steam necessary to heat the coils to the point where they would liquify the oil. The crew had to pump seawater into the hopper to keep the mass of oil moving into the barge, and the steam coils could not produce enough heat to counterbalance the constant influx of the cold waters.

Captain Jimenez and his crew later recommended that an internal hopper steam heating system be developed. (Electrical heaters could pose safety hazards.) The simplest way to implement such a system would be to have a "Donkey Boiler" with the associated steam coils and lines. Another possibility would be to build steam pipes in the hopper or as a quick add-on feature. They also recommended that officials upgrade the vessel's steam plant or install an auxiliary plant.[22]

In addition to steam coils, Corps officials purchased a 12-inch centrifugal pump for the *Yaquina*. When the crew attempted to start the pump they found that the shaft was bent and would not rotate. The crew later tested the 12-inch pump and found that it was too small. Although the pump was portable and powerful, the veins inside the pump were too narrow. Twigs and other debris got caught in the veins, which caused the pump to vibrate and reduced its efficiency. Also, by the time the pump arrived, the oil had become even more viscous. If brought earlier, it might have been more valuable. Although the pump did not work, the crew created an innovative design to hook the pump up. Although they spent $50,000 for a pump that did not work, from it they learned a new off-loading process.[23]

Faced with a painfully slow off-loading process and a 12-inch pump that did not work, *Yaquina* Chief Mate Neal Nyberg and other crew members devised a way to use the dredge's own pumps to remove the mixture from the hoppers, a process called self-off-loading. They put their plan on paper and sent it to officials in Portland for their reaction. When no response came, the crew decided to go ahead and make the adaptations themselves. They "pirated" the necessary materials. The Exxon representative on board helped them get the hose and other equipment. Removing the starboard draghead, they attached the suction hose to a flange over a hole cut at the top of the hopper wall. Adding water to the hopper, they floated the oil up to that opening, then turned on the port side discharge pumps, bypassing the sidecast route and diverting the oil into the barge. Using this method, they off-loaded 1,200 barrels in five hours. The only limitation was that the oil had to be mixed with water, so the barge filled up quickly and the Corps had to decant it by pumping the water back to the dredge.[24]

Unlike the *Yaquina*, the *Essayons* had pumpout capability, a separate internal system to remove material from the hopper. The *Essayons* did not attempt to use its internal system to off-load because of the high percentage of water which would have had to be utilized in order to slurry the oil and pump it. This would require a large barge with the capacity to decant and none was available.

There were other aspects to the off-loading problem as well. Exxon's barges had trouble decanting quickly because of the amount of water being pumped with the oil. Off-loading efforts were also hampered by the fact that barge personnel were inexperienced and overworked. Workers were very tired, some having worked eighteen-hour shifts for three weeks. Barge personnel also lacked adequate knowledge of how to use the proper equipment for each job.[25]

The *Yaquina* crew made various recommendations to enhance off-loading in the future. Exxon barges were not available when the *Yaquina* arrived. The crew recommended that the Corps acquire its own barge, which could be used for containment rather than the hopper. The *Yaquina* had the internal piping for a process called sidecasting, which involves taking dredge material from the river bottom through its pumps and then shooting it off to the side without placing the material in the hopper. The sidecasting piping could be routed directly into the barge so that when boom off-loading began, the product would go directly from the boom through the vessel's pumps and into the barge. This was the best procedure because the vessel transit time to an off-loading barge was eliminated; vessel cleanup time was cut 50 percent; and the product could be safely contained off the vessel. The dredge's overall production could be doubled.

The crew also recommended the addition of hopper screens. When the hopper doors were opened and closed to decant the water, debris tended to catch in the hopper doors and prevent a tight closure. Large screens of "baseball fence size openings" could be fitted above and across each of the hopper doors to screen out any large debris that would keep the door from closing. A stripper pipe could be installed in the hopper rather than installing screen and decanting through the door.[26]

By mid May the amount of recoverable oil on the water surface had decreased significantly and dredge activities declined. The focus of the cleanup had shifted to the shoreline. FOSC and Exxon representatives concluded that the *Yaquina* was no longer needed, and on 26 May it arrived in Seward for cleaning. Local contractors labored to clean the dredge, often using high pressure hot water with detergent. Much of the work, however, involved wiping down and scraping by hand.[27]

By 5 June the *Yaquina* was nearly clean and the FOSC recommended that it be released for return to normal duty. JTF requested that DOMS authorize the dredge to leave Alaska and release it to USACE upon arrival in Portland. DOMS directed that the *Yaquina* be returned to USACE no later than 15 June and commended the crew for their dedication: "Their achievement has been a significant contribution in the national interest." The *Yaquina* arrived in Portland on 15 June. Although environmentalists expressed some concern that the returning dredge might contaminate the Columbia River, Captain Brice countered that it was the cleanest it had been in two years.[28]

Meanwhile, cleaning crews continued work on the *Essayons*. A decision had been made in mid May to allow the oiled debris collected by shore operations to be dumped in the *Essayons*' hoppers in order to ease the disposal problem. The *Essayons* was used as a "collection barge," for contaminated materials from shoreline cleanup. Workers on-loaded roughly 180 cubic yards of the material during operations at Katmai National Monument. On 17 May Colonel Kakel, who had objected to the dredge's use as a "garbage scow," formally requested that the *Essayons* be released on 20 May. Exxon requested that the *Essayons* remain until a hopper barge arrived at the end of May to perform basically the same function. Exxon estimated the final release date to be 15 June. The *Essayons* arrived in Seward for cleanup on 31 May.[29]

Cleaning the *Essayons* at Seward proved to be a long, tiring, messy task. The oily sand, gravel, and debris mixture hardened like asphalt. The Super Sucker broke down; the clam shovel did not work because there was not enough room in the hopper for it or the personnel to operate it. Cleanup started on the topside and outboard hull areas first and work progressed from the top down. Dangerous gases in the hopper forced workers to wear breathing apparatuses. The smell of decaying matter and the oil mixture was likened to a septic tank. Workmen became ill, and work was occasionally stopped for safety reasons. Labor disputes also hampered the cleanup.

By the end of June, eight to ten feet of rock remained in the starboard hopper #1. The crew met with Exxon on the 27th and Exxon officials agreed that it was their decision to put rock in the hoppers and they promised to remove it no matter how long it took.[30]

On the bottom of the hopper there are twelve double-hung doors roughly eight feet square with a linkage in the middle. The seals on the hopper doors leaked because debris had clogged in them and damaged the gaskets. Exxon contended that the vessel owner (the Corps) was responsible for the quality of the door seals and that it should complete the repairs and pay the repair costs that had been incurred since 1 June. An Exxon official concluded, "We propose to take no further action and consider the vessel released." The Corps responded that the leakage was minimal. The *Essayons* finally left for Portland on 19 July and JTF released it to the Corps when it arrived in Portland on 24 July.[31]

On 13 June Secretary Marsh wrote a letter to Commander, USACE, commending the dredge crews. The *Essayons* and *Yaquina* crews, he said, performed "magnificently," working long hours and providing maximum support. "Your initiative and ingenuity to extend the capability of the dredges to collect and skim oil from the water surface," he said, "greatly assisted the skimmer forces in collecting the maximum amount of oil in the shortest possible period of time. I am proud of each and every team member and their collective accomplishments and contributions to overcoming this major environmental disaster."[32]

A very proud Portland District officially welcomed the crew of the *Yaquina* with a ceremony on 20 June at which Colonels Cowan and Kakel and Captain Miguel Jimenez spoke. Captain Brice and Colonel Cowan handed out awards.

The District held a similar ceremony for the *Essayons* crew on 28 July with remarks by Colonel Cowan and dredge captains Ronald Henry and John Gallagher.

The dredge crews traveled to Alaska without any established procedures for oil recovery operations or previous experience. They faced severe problems in locating, loading, and measuring the oil and removing the thick, sticky substance from the hoppers. Yet, through experimentation and hard work, they devised techniques to minimize these problems and to maximize their contributions.