Disposal of petroleum Products Wasted During Defueling Operations in Yukon Territory - Contr DA-572

Chief, Construction Div. Tech Control 3 May 56
J. L. Spangler JLS/217/31

TO: Projects North

1. Attached hereto is Mr. Cook's report on subject matter, together with photographs depicting the actual operations.

2. This report covers disposal of products in five areas. The fuel located at E/W mile 1146.1 was the result of the contractor purging the cut at NBL mile 468.9. This is the only body of fuel that can be directly attributed to the Corps of Engineers operations. The contamination area located at E/W mile 1139.4 was the direct result of the mainline check valve #33 by-pass piping being disassembled during pumping operations at which time several thousand bbls of product was wasted. The contractor disclaims any responsibility whatever for the dismantling of this piping. The other three areas located at E/W mile posts 1142.9, 1151 and 1110 were found to be contaminated resulting from purgings made by AFES personnel.

3. The Canadian Forestry seems to be satisfied with the Corps of Engineers decontamination program but would like to have the hot tap valves locked as soon as possible to prevent pilferage and prevent further contamination of areas. They also requested that they be supplied with a complete listing of hot tap and cut locations.

2 Incls
1. Rpt
2. Photos.

JOHN A. SPANGLER
Technical Control

cc Proj Do

Narrative Report:

Arrived at Fordem 0800 hours [illegible] and picked up Mr. Joe Langevin of the Canadian Forestry Service. Started to visit sites. Mr. Langevin claimed to be covered with oil.

Mile Post 1146.1:

At this site about 1/4" to 1/2" [illegible] contained on surface of an area approximately 100' x 40'. According to Mr. Langevin, this area on first inspection by him, contained oil about [illegible] in depth. Local people had removed the oil in drums and tankers [illegible] April Mr. Langevin had found only three inches of oil on surface when he inspected. Tanker was brought to this location and removal of oil started. From pools of oil on east side of highway (assuming pipeline runs north and south) fluid was passed through culvert under Alaska Highway [illegible] was prepared from which oil was drawn from the top by using a [illegible] as an aid in removing surface oil. Fluid removed from this area taken to gravel pit off highway at MP 1146.7. When attempt was made to [illegible] fluid it would not ignite.

Fluid removed from MP 1146.1: April [illegible] gallons
April [illegible] gallons
[illegible] gallons

The oil from this area came from [illegible] at pipeline MP 268.9 and was made by Williams Brothers.

Grass in this area saturated with [illegible] Langevin believes this will be a fire hazard for some time to come.

Hazard to fish and wild life is possible for [illegible] that two ducks were found in this location, one dead and one almost dead. Some oil has drained into Lake Creek which could endanger fish in the area. There is no evidence of dead fish.

Mile Post 1142.9:

On original inspection made by Mr. Langevin and myself 26 April oil was found to have drained into a lake of approximately 80 acres in size. This lake has no outlet and is quite thickly populated by muskrat. Lake is about three hundred feet from Alaska Highway. Oil covered an area of about 40' by 400' along the shore. Could not pick up oil from this area until 1 May as wind was blowing surface oil away from shore. On 1 May we were able to remove 6000 gallons of fluid from this location of which 4800 gallons were flammable.

The cut in this area was made by operating personnel previous to District Engineer taking over the line.

Hazards to muskrats in lake and their feeding grounds probable.

Fire hazard light but possible.

Mile post 1151:

Oil found in pool alongside road covering an area of approximately 30' x 300' and about 1/2" deep. About 400' distance from road to pipeline and oil is between road and pipeline. This area is highly inflammable. Started pumping oil from this location on 28 April. Total fluid removed from this area 28, 29, and 30 April was approximately 24,000 gallons. All truck loads highly flammable.

Due to grass along highway this area is considered a dangerous fire hazard as entire area is saturated with oil.

Only danger to wildlife exists if ducks light in water at this location.

Oil from this location originated at cut located at pipeline [illegible] 273.5 which was made by operating personnel.

Mile post 1119.4:

This location is a tributary to Swede Johnson Creek. Oil has travelled with ground water from check valve 33. At check valve 33 an area of about 50' by 900' is saturated with oil and originated by bypass being disconnected while pumping. No cuts in this area. Oil has been blocked by elu bridge near highway and the Canadian Army has been asked to dynamite this bridge by Mr. Langevin. When bridge is removed some oil will find its way into Swede Johnson Creek and as this is a grayling stream some damage may be done to fish. 1½

Tried pumping on two occasions without satisfactory results. Into tanker loads totaling 2000 gallons of fluid removed from this location of highly flammable nature.

Fire hazard for some time to come and possible damage to fish.

Mile post 236.5 (pipeline):

Near Quill Creek road. Small lake of about forty acres. This area was burned by Mr. Langevin and oil burned from top of ice. All oil not burned as test with fire prove spots are still flammable. This cut was made by operating personnel.

Possible damage to muskrats and their feeding grounds. Fire hazard light.

Mile Post 246.5 (Tap):

This tap is on shore of muskrat lake about 1¼ miles south of Station 2b. On first inspection Mr. Langevin did not consider this a hazard. However, on closer inspection he noted some oil. I do not believe this is a hazard because of the quantity of oil released in this area.

WES C. COOK
Inspector

Deicing Operations; Haines-Fairbanks Pipeline
Contract DA-95-507-eng-573

1. Narrative:

Contractor established headquarters at Burwash Landing, Yukon Territory on 16 January 1956, and exploratory work began immediately. This work involved becoming familiar with the terrain; securing information as to probable ice restriction locations; locating line cuts previously made and "hot taps" installed by the APPS personnel.

Information received from this source, revealed that the pipeline had been cut and unsatisfactory purgings made in approximately 7 locations. Six of these cuts located in the Edith Lakes and Quill Creek Areas were tied in with weld ends but not welded. The remaining cut was in the Mines and Nines Area and was not tied in. Restrictions were still known to be upstream of this cut, exact locations unknown, but assumed to be in the vicinity of Soldiers Summit and Slims River.

A north line pressure of 1000 lbs. psi was requested to be maintained at Station 2A for the purpose of locating pressure differentials which would indicate restrictions. Readings were then taken, starting at Station 2A and continuing on downstream to approximately mile 206 where low pressures were encountered.

By 23 January, sufficient equipment had arrived in Yukon Territory to start ice removal operations and the first cut was made at mile 206.1. Purging was carried on through this open end for a very short time when a restriction occurred upstream and the flow cut off. Cuts were subsequently made at miles 203.6, 196.4 and 195.8. Considerable quantities of ice, measuring of full 8", quarter and half round sections down to granular in size were removed together with a large amount of very dirty fuel. Flow was recorded at better than 500 bbls/hr which gave a full pipe at the open end.

It was believed that the line was clear of restrictions from Haines to this point and therefore, the open end was tied in and purgings continued through the previous cuts with additional cuts and purgings made at miles 196.4, 197.1 and 205. Tie-ins were made and welded after line was cleared. Operations then moved to the first cut made at mile 206.1. After removal of great quantities of ice a full flow was had at the open end and the line was tied in and the spread continued north or downstream. The pipeline was now complete from Haines to the open end at Mines and Nines Creek.

Further restrictions were located at miles 207.5, 208.2 and 208.6. Cuts were made at these locations, the line was purged and great quantities of ice removed. The open end left by APPS was then purged and tied in, after which pumping operations were resumed. A pressure rise at Tok Station 3 was recorded and product was received at approximately 100 bbls/hr. This rate of flow gradually deminished until a solid restriction built up, which was located at mile 217.1. A line cut was made, ice removed and tie-in completed.

The line was then cut at 217.4, just upstream of a 400' of glacier. 900 gallons of alcohol was pumped in the pipe under the glacier and left over night. The next morning the open end was purged, ice removed and tie-in made. Pressure was then built up against the partial ice restriction under the glacier, which gradually moved and product was again received at Tok Station.

The pumping continued for five days receiving at Tok at the rate of 100 bbls per hour to 0. During this time 700 gallons of alcohol was pumped into the line at Station 2B. to remove partial ice restrictions at this location. Weld ends installed previously by the Using Service were also welded and completed at this time.

Pumping at the above rate continued until 15 February, at which time the line was blocked solid at Mile 253. During the ice removal operations at this cut, a block formed at 252.4 which was subsequently removed. After both open ends were tied in, pumping operations were resumed.

A restriction immediately built up south of Station 2B and ws located near Mile 231. The ice was removed and operations moved ahead to Mile 251.4 where considerable ice, consisting of full 8" sections and large quantities of broken pieces of 3/4 to 1/4 full pipe size to granular ice resembling coarse salt was removed.

Icewas also removed from Mile 253.4, before product was again received at Tok. The next restriction built up south of 2B and cuts were made at 247.9 and 236. The high pressure pump was used at Station 2B at this time to force out ice between the station and the open cut at 247.9.

Soon after pumping was resumed a restriction built up at Mile 242. After this ice was removed Tok started to receive at a rate of 165 bbls per hour.

The scraper traps were removed at Station 2B and a direct 8" connection made between the two trap valves. This was done to provide free flow of ice by the station without going through the tube turns and fitting at the installation.

Pumping operations were then "jockeyed" so as to create turbulence and solidly plug the line. This resulted in a restriction at Mile 274.5. Pipe was cut but purging was unsuccessful due to more restrictions building up upstream. Ice was then removed at 264.8, 273.5, 268.9, 266.0 and 256.8 before the open end at 274.5 was successfully purged and tied in.

This operation was completed on 4 March and Tok started to receive at the rate of 400 bbls per hour. Pumping at this rate continued until 6 March when line was again plugged. This restriction was located at Mile 303.5 and subsequently removed.

Pumping operations were again resumed and continued with periodic restrictions until 11 March when flow stopped entirely. Restriction was located near Mile 377. In this area the products line contained several tenders and a

cut and purge would increase the size of the interfacss. In view of this, cradling and fire methods were used to move and break up the restriction permitting it to be pumped into the tanks at Tok. This was successful to the extent of moving it to Mile 382.5 when it was decided to cut and remove the ice. This was done and 90' of ice built up of small particals compressed to a solid mass was taken out. This was the last cut made in the ice removal operations.

Pumping was resumed and Tok Station 3 started to receive at 1836 hours 16 March and continued at an average rate of 400 bbls/hr until bulk fuel storage at Haines was depleted. An inventory of 13,500 bbls was kept at Haines for line packing purposes. A minimum of 900 lbs. psi south line pressure was maintained at Tok Station and excesses over 1200 lbs. psi were bled off.

A tanker discharged at Haines on 24 March and pumping into Tok was resumed on 26 March. Operations were directed to place Station 2B on the line on 29 March. This increased the flow rate to a maximum of 680 bbls/hr. At this time two pumps were in operation at Haines, Station 2 and one pump at Station 2A and 2B, respectively.

This turbulent flow immediately changed the appearance of the flow chart at Tok, indicating movement of ice plugs. Ice started to come into Tok Station during the night and continued until operations were shut down on 3 April.

During the last pumping operation a final inspection of the deicing areas was made. Locations of "hot taps" and cuts were recorded and the welds checked for leaks and for non-completion. Skids were removed and the pipeline placed in its original position. Areas where burning occurred were checked and any latent fires were extinguished. The by-pass that was installed at Station 2B was removed, placed in storage and the scraper traps replaced. Demobilization of contractor personnel and government furnished equipment was carried on during this last operation and the supervisory element arrived in Anchorage 3 April 1956.

The following "hot taps" were made by the contractor:

POL Milepost	H/Way Access Road	POL Milepost	H/Way Access Road
192	1066	208	1082.5
195.5	1066	208.7	1082.5
196.2	1066	209.2	1082.5
196.5	1066	210.4	1082.5
196.9	1066	212.2	1082.5
197.1	1066.6	213.2	1084.6
197.9	1066.6	216.2	1084.6
203.4	1074.9	216.9	1084.6
204	1074.9	217.3	1084.6
204.9	1074.9	217.4	1084.6
207.9	1082.5	217.5	1084.6

POL Milepost	H/Way Access Road	POL Milepost	H/Way Access Road
217.9	1084.6	255.4	Donjeck Bridge So.
220.5	1092	256.8	Donjeck Bridge No.
225	1092	264.4	1142.5
230.4	1092	266.1	1143.5
232	1107.3	267.2	1148
232.8	1107.3	268	1148
233.4	1107.3	268.8	1148
235	1110	270.6	1148
236	1110	271.5	1148
236.8	Quill Creek Rd.	272.1	1148
241	1117	273.1	1148
242	1117	274.5	1152
246.5	1122.4	296	1174
247.9	Station 2B	300.4	1178.8
248	1124	302.4	1181
248.7	1124	379	1266
250.6	1124	380	1266
251.4	1124	381	1266
252.2	1124	382.1	1266
252.9	1124		
253.4	1124	Total of "hot taps" 62	

The following cuts were made in the pipeline:

Cut Number	POL Mile	Date Cut	Date Purged	H/Way Mile Access Rd.
1	206.1	23 Jan.	2 Feb.	1074.9
2	203.6	24 Jan.	31 Jan.	1074.9
3	196.4	28 Jan.	29 Jan.	1066
4	195.8	29 Jan.	29 Jan.	1066
5.	197.1	30 Jan.	30 Jan.	1066.6
6	205.0	1 Feb.	2 Feb.	1074.9
7	207.6	2 Feb.	3 Feb.	1082.5
8	208.2	3 Feb.	4 Feb.	1082.5
9	208.6	4 Feb.	4 Feb.	1082.5
10	217.1	9 Feb.	9 Feb.	1084.6
11	217.4	9 Feb.	10 Feb.	1084.6
12.	253.0	16 Feb.	17 Feb.	1124
13	252.4	17 Feb.	17 Feb.	1124
14	233.2	18 Feb.	18 Feb.	1107.3
15	251.4	19 Feb.	19 Feb.	1124
16	253.4	21 Feb.	21 Feb.	1124
17	247.9	22 Feb.	23 Feb.	1124
18	236.0	22 Feb.	22 Feb.	1110
19	242.0	24 Feb.	24 Feb.	1117
20	268.0	25 Feb.	25 Feb.	1146.1

Cut Number	POL Mile	Date Cut	Date Purged	H/Way Mile Access Rd.
21	274.5	26 Feb.	4 Mar.	1152
22	264.8	28 Feb.	26 Feb.	1142
23	273.82	29 Feb.	3 Mar.	1148
24	266.9	1 Mar.	1 Mar.	1146.1
25	266.0	1 Mar.	1 Mar.	1143.6
26	256.8	2 Mar.	2 Mar.	1133.6
27	303.5	7 Mar.	7 Mar.	1182
28	382.5	16 Mar.	16 Mar.	1266

The above listed cuts are plotted on Sketch #_____ Exhibit #_____.

A close estimate of the quantity of ice removed during operation is not available. A rough estimate would be in excess of 500 cubic yards. Large quantities of small pieces of ice and slush was washed away during operations, mixed in with the snow or washed under the snow. The writer was also unable to witness each purge.

During each operation continuous contact was maintained with the dispatcher at Haines and the information received by radio and messenger from the field was passed on to the dispatcher who no doubt entered same in the log.

In order to estimate the quantity of fuel pumped on the ground the following should be taken into consideration:

a. No practical method could be devised to meter the flow at the open cut.

b. Displacement of the ice removed from the line.

c. The seven (7) cuts made previously by APPS, many of which were made consecutively upstream, leaving the line dry or floshed.

d. Re-packing the line.

e. The loss of product at Gate Valve 28 (Slims River). The relief bleeder valve was found open by the deicing crew and large area was saturated to a depth of 5 feet or better.

Pumping records at the dispatcher's office would be the only means of determining the number of barrels lost in the above operation.

PART 2 - Deicing Methods Employed

The following equipment and material was used by contractor and Corps of Engineer personnel:

1. 3 sedans w/2 way radios.
2. 2 only M37 - 4 x 4 pickups for welders. One equiped with 2 way radio.
3. 3 only M37 - 4 x 4 pickups for material and personnel carriers.
4. 1 only 750 gallon tank mounted on a 6 x 6 truck.
5. 1 only 2,000 gallon tank trailer.
6. 2 only 5 ton truck tractors.
7. 2 only 20 ton low boy trailers.
8. 1 only D6 cat with angle blade.
9. 2 only D6 side boom cats w/bending shoes.
10. 2 only 200 AMP Lincoln welders.
11. 1 only high pressure pump w/prime mover and high pressure fittings.
12. 5 pair of snow shoes.
13. 4 only Walkie Talkie Radios.
14. 2 only Lazy Linemen field telephone sets modified for APPS circuit.
15. 6 only 2000# gauges.
16. 2000 gallons of alchol.
17. 25 only "weed burners".
18. 28 "weld ends".
19. 62 only 1" high pressure 600 lb. gate valves with HP bull plugs and swadge nipples.
20. First Aid and fire extinguishing equipment.
21. Sledge hammers for sounding pipe.
22. Axes, shovels and picks.

23. 2 only 8" pipe "squeeze" plugs.

24. 1 only 8" pipe cutters with spare wheels.

25. 2 only gas welding torches with spare bottles and tips.

26. 1 only 8" beveling machine.

27. Miscellaneous tools, that is, crescent and pipe wrenches, files, wire brushes, chipping hammers, etc.

28. 1 set of 8" pipe cradles.

Contractor personnel by classification:

1 general superintendent
1 superintendent
1 office manager
1 welder
1 heavy duty truck driver
3 light duty truck drivers
3 laborers
3 cat operators
1 welder helper
1 heavy duty mechanic

The deicing operations were carried on without benefit of criteria and methods used were strictly experimental until their adequacy was established. The main objectives were (a) to clear the line as soon as possible (b) conserve the product (c) protect natural resources, and (d) the safety of personnel.

In order to pump as little fuel as possible on the ground, the theory of plugging the line solid before cutting worked to a great advantage. Cuts were made in most cases in a location distant from any roads or habitation, with due consideration given to water sheds. However, in some instances this was not possible and a minimum amount of purging was done with the expectation of making another cut further on in a better location.

In locating solid restrictions, a pressure differential method was used. A chart was made showing static pressure readings to be had at all gate and check valves and at other geographical locations, with a 1000 lbs. psi maintained at Staion 2A. The next operation was to take pressure readings at the valve locations where taps were provided during the construction of thepipeline. When a reading lower than what was pre-determined was taken, it was assumed that the restriction was between that valve and the last reading taken. A "hot tap" was then welded on the line midway between readings after which pressures were read to determine the direction of the restriction. This operation repeated until the plug was pinned down to within a mile area.

Line walkers were then utilized. The peculiar sound obtained from a sharp rap on the pipe with a 10 lb. hammer indicated the presence of ice. A ring indicated a clear pipe whereas a dull thud showed ice.

The next step after locating the plug was to install a "hot tap" down stream and near the proposed cut. A pressure gauge was then installed at the "hot tap" thereby providing the welder and helper with an assurance of a low pressure during cutting operations. The locations of the restrictions were marked when found and where a large plug was located, a brush gang placed logs and brush which were in turn saturated with fuel from the pipeline. The 750 gallon tanker was used for this purpose. See photograph. In the meantime the gate valves both upstream and downstream were closed and communications were set up.

In the event that the upstream gate valve was located out of radio range a "Lazy Lineman" field telephone was set up on the highway near the valve, and a man stood by with a M37. The radio equiped car operated by either the Project Engineer or the General Superintendent was located near the cut and under the telephone lines. In some instances, a road was dozed out for the car which in turn was towed to location by a tractor. A "Lazy Lineman" phone was then hooked up to the car. The radio equiped truck was located at the proposed cut site. In some cases, the key car was several miles from the cut location. As car radios were not provided until late in the program, walkie talkies were used. Due to the extreme low temperatures and their very short range, the battery operated radios were very unsuccessful. Haines dispatcher was then alerted on the phone and an operator stood by at all times. Communications were tested and the cutting operation proceeded.

A dozer was dispatched to the purge site and a collection basin was provided. This was unsuccessful in most instances, due to the ground being frozen and snow and tundra alone was not sufficient to impound the fuel. In this case, a trough was made in the snow diverting the product from the R/W. The pipeline was then moved from the right/way to the purging area by side boom cats and then cut. The upstream end of the cut was then moved further away from the R/W and the other end, after being drained, was returned to the R/W, where a weld end would be installed during purging.

Pressures at this time would be permitted to drop to approximately 700 pounds at Station 2A. Operations were directed from the car located under the telephone lines near the cut. In the meantime, the side boom cats, equiped with cradles, were working the line where the ice was known to be. This is accomplished by placing the cradle under the pipe and raising it up approximately 4 to 5 feet and moving along the R/W. The theory advanced here was that the steel pipe would flex whereas the ice would breakup and free itself from the side walls. This method proved to be very adequate. The brush crew was alerted and stood by to light the fires already prepared when notified.

At this time all the upstream pumps were put on the line and set for maximum output. Pressures and flows were constantly given to the communication car through

the use of telephone hookup. At a time just before the pumps would automatically be put off the line due to high pressure, the man stationed near the upstream valve was directed to immediately proceed to open the valve. At the same time the fires would be lit.

The line was then purged through the open end and ice and crud removed. The length of time purgings were carried on was determined by a full even flow of fuel without much ice; pressure checks at stations which would indicate no restrictions or in some instances the terrain would not safely hold more fuel. In the latter case, the line would be tied in and attempts made to plug the line solidly at another location.

When it was decided to discontinue purging, the station operators would be alerted to watch for pressure rises as the upstream gate would be closed. The valve tender would then be directed to close valve. When he verified that the valve was secured, the line personnel at the open end would be notified and tie-in operations would commence.

The downstream end of the line complete with weld end and with a "pup" of proper length added during purging would be moved from its location in the R/W to its cutting location. This welding was accomplished safely by inserting a mechanical plug in the line to shut off vapors and/or fuel, and after completion of the weld this is removed. This insertion and removal is done off the R/W, thereby enabling the welder to work in an area that is not contaminated by fuel. The pipe was then tied together and moved back to the R/W for final welding.

The next step is to open the downstream valve. Then the station operators were alerted to watch for a pressure drop when the upstream valve was opened. When this drop occurs pumping starts at a reduced rate permitting a mixmum of 350# psi pressure at the weld end. Air is then bled off the line using the "hot taps" previously installed.

When the pressure at the weld end reaches the desired amount, the weld is made. During welding operations, communication was maintained to protect the welder from excess or negligible pressures. The above described operation was repeated at each plug.

The operation outlined above did not in all cases work satisfactorly. In the event the ice restriction did not free itself before the pressure at Station 2A reached 1100 lbs, the pumps had to be taken off the line, and cradling and fires would have to be continued until the restriction moved. When this movement occurred the built up pressure would be dissapated with the first surge. This drop of pressure would not be reflected for some time at the pump stations thereby results a minor flow out the open end until the pumps could be returned to the line. In this case the upstream gate would be closed until the start up operation previously outlined could be repeated.

It was found that a small flow did not move ice to the open end but merely caused great quantities of fuel to be wasted without obtaining the desired results. Failure of communications often caused delays in carrying out the purgings. Contact

was lost many times with the end of the line necessitating the sending of messengers to and from the communication car by tractor or 4 wheel drive vehicle for distances up to three miles and in some cases as far as twenty miles to the shut-off valve. During these delays quantities of fuel was needlessly wasted. Pumping orders could not be changed or valves operated without firm knowledge of conditions at the open end without jeopardizing the safety of personnel working there.

Summary:

Fires were used to an advantage for moving solid and stubborn restrictions or to apply heat to shallow buried sections. In some cases fires were built just upstream on the surface laid pipe before entry into deep burial. This supplied heated fuel through any partial restrictions in the burial. Fires were also used to an advantage in moving restrictions to another area where purging could be done without creating a potential hazzard. This operation is recommended to be used only in extreme cases.

Fires were found to be very detrimental if the pipe is not cut. This causes a solid block of pure ice further down stream which can be removed only with great difficulty. The APPS personnel had done this in the Edith and Lakes Creek areas without purging and cuts had to be made during this de-icing program at practically every location where there had been a fire. Weed burners were used only to set off the fuel saturated brush fires and to warm up engines prior to starting in severe cold weather.

The use of alchol was not thoroughly tested as a medium of removing ice. It is considered of value only in cases as outlined previously in this report, that is removing restrictions in the station areas where fire and cuts cannot be used, or in deep burials. Considerable time was necessary before the effects of the alcohol on the ice was apparent.

Cradling the pipe using side booms was found to be very effective and it is believed this operation speeded up the ice removal considerably.

Complete control of pumping operations is absolutly necessary. If requested pressures and/or volume is not received on time even in some cases for minutes a complete disruption of operations can result causing delays and possible injury to personnel.

Flow rates of under 500 barrels per hour is not recommended. Higher flows cause a turbelance in the pipe which moves the broken pieces of ice considerably faster and scours the line.

A great deal of knowledge can be gained from a study of the pressure and flow charts. As an example, if the line is being purged in the downstream side of Station 2B and the pressure chart shown fluctuation, this is a good indication that the ice is being pushed to the open end. A smooth even line on the chart indicates restriction is not moving and if the pressure reading conforms to the flow the line is clear. In receiving at Tok Station, a close study of the flow chart is advisable. Sharp rises

and drops of severe intensity with no set pattern indicates a restriction being moved along the line. A rapid rise and fall of the chart and following a set pattern indicate solids in line that are not moving. By increasing the pumping rates the chart pattern can be changed to the more desirable sharp fluctuation thereby moving the ice downstream and subsequently into the storage tanks.

A Safety Survey of the Thawing Operations was made by Mr. W. King, Chief Safety Branch, Mr. W. J. Wilson, Forest Engineer, Department of Northern Affairs and Natural Resources, Mr. Joe Langarin, Park Warden, Yukon Forestry Division and Mr. Spangler, Project Engineer.

It was decided that burning of the wasted fuel would creat a greater hazzard than permitting the fuel to dissipate in the atmosphere.

The Safety program was good during the ice removal operations. There were no lost time accidents or any reportable vehicle or equipment damages.