

*Crested Ice
File #10*

FINAL HEALTH PHYSICS REPORT ON
PROJECT CRESTED ICE

PREPARED BY:

John C. Taschner
JOHN C. TASCHNER
MAJOR, USAF, BSC
HEALTH PHYSICIST

Lars Bötter-Jensen
LARS BÖTTER-JENSEN
DANISH ATOMIC ENERGY COMMISSION
HEALTH PHYSICIST

FINAL HEALTH PHYSICS REPORT ON
PROJECT CRESTED ICE

DATE: 14 September 1968

PREPARED BY: Major John C. Taschner
Health Physicist
USAF Radiological Health Laboratory (SGHW)
Wright-Patterson AFB, Ohio, USA

Lars Bötter-Jensen
Health Physicist
Danish Atomic Energy Commission
Research Established Risø
Roskilde, Denmark

I. Instrumentation Used For Radiation Surveys

A. FIDLER

1. The FIDLER is a low energy X- and gamma ray detector developed by the Lawrence Radiation Laboratory, Livermore, California, for radiation surveys of plutonium contaminated areas. Two such instruments are on load to the U.S. Air Force in support of Project "Crested Ice".

2. The FIDLER consists of a detector probe, an Eberline Pulse Rate Meter (Model PMR-5) and earphones for audible indication of radioactivity. The detector probe consists of a thin sodium-iodide crystal optically coupled to a photomultiplier tube. The pulse rate meter may be adjusted to measure the 17 keV X-rays from plutonium -239 or the 60 keV gamma rays and the 17 keV X-rays from americium -241 (a decay product of plutonium -241). The ability to measure plutonium contamination by means of X- or gamma ray detection, rather than the slow, tedious process of alpha monitoring, has made the FIDLER an invaluable instrument for Broken Arrow operations.

3. External battery packs were connected to the PMR-5 to allow the radiological monitor to carry the batteries in his pocket to prevent a decrease in battery efficiency due to freezing temperatures.

B. PAC-1S (AN/PDR-60)

1. The PAC-1S is the standard U.S. Air Force alpha survey meter developed by Eberline Instrument Company, Santa Fe, New Mexico. Full details on this instrument are available in T.O. 11H4-4-2-31, -32, -33, and -34 or from the manufacturer.

2. Battery packs were also connected externally to the PAC-1S.

C. Staplex Air Sampler

1. The Staplex High Volume Air Sampler developed by the Staplex Company, Brooklyn, New York, was used for sampling large volumes of air for the assessment of airborne plutonium contamination.

2. The unit was equipped with an 8x10 inch filter paper holder and Whatman No. 41 filter paper was used as the particulate collection medium.

II. Radiation Surveys

A. Contaminated Waste Containers

1. To insure the radiological cleanliness of all containers to be shipped from Thule Air Base, external surfaces of the containers located in the Tank Farm and Igloo Areas were monitored. Any measurable radioactivity was removed with Stoddard Solvent (PS-661).

2. Swipe samples, using Whatman No. 1 filter paper, were taken in order to assess the efficiency of decontamination procedures. These samples were obtained by wiping a 100 cm² area adjacent to the container openings. The samples were forwarded to the USAF Radiological Health Laboratory (SGHW) for analysis. Swipe sample results appear in attachment 1-4 of this report. Technical Order OO-110N-2 states that the maximum permissible alpha activity is 100 pCi per/100cm² swipe. All containers showing swipe sample values greater than 100 pCi were decontaminated.

B. Hangar No. 1

1. An area of approximately 30 square feet in hangar no. 1 was surveyed following the clean-up of approximately 20 gallons of liquid waste from an R-4360 container. No detectable activity was measured.

2. To insure that decontamination procedures were completely effective, ten representative swipe samples were taken in the area and were forwarded to the USAF Radiological Health Laboratory for analysis. All swipe samples showed no detectable activity.

C. Igloo Area

1. Two igloos and adjacent areas were used to store various size POL tanks, R-4360 engine containers and 55 gallon drums, all containing contaminated pieces of aircraft gathered at the crash site.

2. Following the loading of these containers aboard ship the igloos and adjacent areas were surveyed with the FIDLER and PAC-1S instruments. No detectable radioactivity was measured. This area may be returned to normal use.

D. Tank Farm

1. Contaminated snow, ice, and debris were removed from the crash site and placed in 25,000 gallon POL tanks located in the tank farm during the initial phase of Project "Crested Ice". Health physics surveillance over this area during the transfer of the melted snow and ice to R-4360 containers was reported in Section IV of the SAAMA Task Group Report.

2. During the transfer of the POL tanks and R-4360 containers to the dock for loading aboard ship, health physics activities consisted of monitoring the truck tires with a PAC-1S instrument and examining the containers for leaks. In addition, the ground was monitored with the FIDLER after each tank was removed. All tanks which were found to be leaking were returned to the tank farm for repair. The tanks were then monitored to insure radiological cleanliness prior to leaving the tank farm.

3. Following the removal of all R-4360 containers and POL tanks from tank farm, the area was monitored with the FIDLER. Several isolated areas of plutonium contamination were detected. These areas are shown in attachment 5 as locations A through I. Attachment 6 shows the FIDLER and PAC-1S measurements made at these locations before and after decontamination. Decontamination was accomplished by removal of the soil until the FIDLER instrument readings were less than two times background. Normal background appeared to be approximately 250 count per minute.

E. Vehicles

1. The Wanagan located adjacent to the tank farm and all vehicles used to transport the contaminated waste containers to the dock were monitored at the conclusion of the operation. No detectable activity was measured.

F. Roads Leading To The Dock

1. All roads used to transport the contaminated waste containers to the dock were monitored after the last POL tank was removed from the tank farm. No detectable activity was measured.

G. Coastline Survey

1. A coastline survey was performed along the route indicated by the red line on attachment 7. No detectable activity or aircraft debris was found.

III. Special Problems

A. Fire In POL Debris Tank No. 74

1. The fire in this tank, caused by welding sparks, presented the possibility of airborne radioactive contamination and a potential health hazard to the firemen. All firemen involved in controlling the fire were issued Scott Air Packs (supplied air systems) to prevent the possibility of an inhalation hazard and were told to remain upwind of the fire. Air samples were taken downwind and no detectable activity was measured. Furthermore, the clothes of the firemen were monitored periodically and no detectable activity was measured.

2. Swipe samples taken from inside the tank were sent to the Danish AEC Health Physics Department and the USAF Radiological Health Laboratory for analysis. The results indicated that no detectable activity collected on the inside of the tank during the fire.

3. It is concluded that the contents of the tank were not sufficiently contaminated to present an airborne radioactive hazard.

IV. Conclusion

All areas which were involved in Project "Crested Ice" have been cleaned and monitored so that no radioactive contamination above maximum permissible levels remains. It is therefore concluded that these areas may be returned to normal use.

7 Atch

1. Swipe Sample, OL-5 Igloo Area
2. Swipe Sample, R4360 Engine Containers
3. Swipe Sample, POL tanks
4. Swipe Sample, R4360 Engine Containers
5. Tank Farm Radiation Survey
6. Activity Levels of Contaminated Areas, Tank Farm
7. Coastline Radiation Survey

SWIPE SAMPLE RESULTS ON 55 GALLON
DRUMS LOCATED AT OL-5 IGLOO AREA
(15-18 JULY 1968)

<u>SWIPE SAMPLE NO.</u>	<u>BARREL NO.</u>	<u>PALLET NO.</u>	<u>RESULTS</u>
1001	500	1	NDA*
1002	527	1	NDA
1003	523	1	NDA
1004	528	1	NDA
1005	526	2	NDA
1006	525	2	NDA
1007	503	2	NDA
1008	501	2	NDA
1009	504	3	NDA
1010	502	3	NDA
1011	505	3	NDA
1012	524	3	NDA
1013	145	4	NDA
1014	149	4	NDA
1015	147	4	NDA
1016	148	4	NDA
1017	154	5	NDA
1018	150	5	NDA
1019	152	5	NDA
1020	151	5	NDA
1021	153	6	NDA
1022	141	6	3 [±] 2 pCi**
1023	138	6	NDA
1024	142	6	NDA
1025	139	7	NDA
1026	143	7	NDA
1027	140	8	NDA
1028	506	8	NDA
1029	144	8	233 [±] 13 pCi
1030	146	8	NDA
1031	125	9	NDA
1032	121	9	NDA
1033	127	9	NDA
1034	122	9	NDA
1035	120	10	NDA
1036	126	10	NDA
1037	124	10	NDA
1038	134	10	NDA
1039	135	11	18 [±] 4 pCi
1040	129	11	66 [±] 7 pCi
1041	133	11	NDA
1042	131	11	NDA
1043	128	12	NDA
1044	136	13	NDA

Atch 1

1045	137	13	NDA
1046	132	13	NDA
1047	130	13	NDA
1048	158	14	NDA
1049	157	14	27 [±] 4 pCi
1050	159	14	NDA
1051	160	14	3 [±] 1 pCi
1052	161	15	NDA
1053	162	15	2 [±] 1 pCi
1054	103	15	29 [±] 4 pCi
1055	507	16	NDA
1056	513	16	NDA
1057	155	16	2 [±] 1 pCi
1058	156	16	375 [±] 16 pCi
1059	510	17	NDA
1060	508	17	NDA
1061	512	17	NDA
1062	514	17	NDA
1063	511	18	NDA
1064	522	18	NDA
1065	517	18	NDA
1066	119	18	NDA
1067	12	19	NDA
1068	28	19	NDA
1069	13	19	NDA
1070	29	19	NDA
1071	14	20	NDA
1072	15	20	2 [±] 1 pCi
1073	30	20	NDA
1074	31	20	NDA
1075	39	21	NDA
1076	103	21	NDA
1077	38	21	NDA
1079	102	21	3 [±] 2 pCi
1080	36	22	NDA
1081	100	22	NDA
1082	37	22	NDA
1083	101	22	NDA
1084	516	23	NDA
1085	520	23	NDA
1086	515	23	NDA
1087	519	23	NDA
1088	114	24	NDA
1089	521	24	NDA
1090	518	24	NDA
1091	509	24	NDA
1092	18	25	NDA
1093	21	25	NDA
1094	16	25	NDA
1095	20	25	NDA

1096	17	26	NDA
1097	22	26	NDA
1098	113	26	NDA
1099	104	26	NDA
1100	107	27	NDA
1101	111	27	NDA
1102	110	27	NDA
1103	109	27	NDA
1104	10	28	NDA
1105	25	28	NDA
1106	9	28	NDA
1107	24	28	NDA
1108	11	29	NDA
1109	8	29	NDA
1110	26	29	NDA
1111	27	29	NDA
1112	45	30	NDA
1113	33	30	NDA
1114	46	30	NDA
1115	32	30	NDA
1116	47	31	NDA
1117	34	31	NDA
1118	44	31	NDA
1119	35	31	NDA
1120	49	32	NDA
1121	52	32	NDA
1122	50	32	3 ⁻ 1 pCi
1123	53	32	NDA
1124	48	33	NDA
1125	55	33	NDA
1126	51	33	NDA
1127	54	33	NDA
1128	116	34	NDA
1129	2	34	NDA
1130	118	34	NDA
1131	5	34	NDA
1132	115	35	NDA
1133	1	35	NDA
1134	117	35	NDA
1135	3	35	NDA
1136	106	36	NDA
1137	123	36	8 [±] 2 pCi
1138	105	36	NDA
1139	6	36	NDA
1140	112	37	NDA
1141	4	37	NDA
1142	108	37	NDA
1143	7	37	NDA
1144	71	38	NDA
1145	89	38	4 [±] 2 pCi
1146	69	38	NDA
1147	88	38	NDA

1148	70	39	NDA
1149	91	39	NDA
1150	68	39	NDA
1151	90	39	NDA
1152	43	40	NDA
1153	61	40	NDA
1154	41	40	31 [±] 5 pCi
1155	62	40	NDA
1156	40	41	NDA
1157	60	41	NDA
1158	42	41	5 [±] 2 pCi
1159	63	41	NDA
1160	73	42	NDA
1161	80	42	4 [±] 2 pCi
1162	74	42	NDA
1163	83	42	NDA
1164	75	43	5 [±] 2 pCi
1165	82	43	NDA
1166	72	43	NDA
1167	81	43	7 [±] 2 pCi
1168	95	44	NDA
1169	94	44	NDA
1170	78	44	NDA
1171	79	44	NDA
1172	92	45	NDA
1173	76	45	NDA
1174	93	45	NDA
1175	77	45	NDA
1176	56	46	NDA
1177	66	46	NDA
1178	59	46	NDA
1179	64	46	NDA
1180	57	47	NDA
1181	58	47	NDA
1182	65	47	NDA
1183	67	47	NDA
1184	96	48	NDA
1185	84	48	NDA
1186	98	48	NDA
1187	85	48	NDA
1188	99	49	NDA
1189	97	49	NDA
1190	19	49	NDA
1191	23	49	NDA
1192	86	50	NDA
1193	87	50	NDA

*NDA - No detectable activity

**pCi - Picocuries (10^{-12} curies)

SWIPE SAMPLE RESULTS FOR R4360 ENGINE
CONTAINERS LOCATED IN THE IGLOO AREA
(16 JULY 1968)

SWIPE SAMPLE NO.

RESULTS

R-230	NDA*
R-236	NDA
R-237	NDA
R-238	4 ± 2 pCi**
R-239	NDA
R-240	NDA
R-243	NDA
R-244	15 ± 3 pCi
R-245	NDA
R-246	NDA
R-247	NDA
R-248	NDA
R-249	NDA
R-250	NDA

*NDA - No detectable activity

**pCi - Picocuries (10^{-12} curies)

NOTE: Swipe sample No. R-XXX designates the serial number of the R-4360 engine container from which the sample was taken.

SWIPE SAMPLE RESULTS ON POL TANKS LOCATED
IN THE IGLOO AREA (18 JUL 68)

<u>SWIPE SAMPLE NO.</u>	<u>RESULTS</u>
0-1	NDA*
0-2	NDA
0-3	NDA
0-4	NDA
0-5	NDA
0-6	NDA
0-7	NDA
0-8	NDA
0-9	NDA
0-10	NDA
0-11	NDA

*NDA - No detectable activity

NOTE: Swipe sample No. O-XX designates the POL tank number
from which the sample was taken.

Atch 3

SWIPE SAMPLE RESULTS FOR R4300 CONTAINERS
 LOCATED IN THE TANK FARM (27 Jul - 31 Aug)

<u>SWIPE SAMPLE NO.</u>	<u>RESULTS</u>
001-007	NDA*
008	7 \pm 2 pCi**
009-010	NDA
011	3 \pm 1 pCi
012-018	NDA
019	5 \pm 2 pCi
020-022	NDA
023	2 \pm 1 pCi
024	4120 \pm 5 pCi (1)
025-027	NDA
028	6 \pm 2 pCi
029-035	NDA
036	2 \pm 1 pCi
037-041	NDA
042	2 \pm 1 pCi
043	12 \pm 3 pCi
044-051	NDA
052	2 \pm 1 pCi
053	2 \pm 1 pCi
054-056	NDA
057	2 \pm 1 pCi
058	8 \pm 4 pCi
059	2 \pm 1 pCi
060-068	NDA
069	20 \pm 4 pCi
070-071	NDA
072	158 \pm 11 pCi (1)
073-075	NDA
076	2 \pm 1 pCi
077-080	NDA
081	3 \pm 1 pCi
082	NDA
083	8 \pm 2 pCi
084-089	NDA
090	2 \pm 1 pCi
091-093	NDA
094	15 \pm 3 pCi
095-100	NDA
101	9 \pm 3 pCi
102-111	NDA
112	6 \pm 2 pCi
113	20 \pm 4 pCi
114-116	NDA
117	6 \pm 2 pCi
118-132	NDA
133-134	2 \pm 1 pCi
135-140	NDA
141	2 \pm 1 pCi
142	5 \pm 1 pCi
143-145	NDA

146	3 [±] 2 pCi
147	4 [±] 2 pCi
148	NDA
149	3 [±] 2 pCi
150-152	NDA
153	2 [±] 1 pCi
154-155	NDA
156	2 [±] 1 pCi
157-161	NDA
162	3 [±] 1 pCi
163	NDA
164	13 [±] 3 pCi
165-166	2 [±] 1 pCi
167-168	NDA
169	6 [±] 2 pCi
170	NDA
171	2 [±] 1 pCi
172-178	NDA
179	2 [±] 1 pCi
180	NDA
181-182	2 [±] 1 pCi
183-184	NDA
185	15 [±] 3 pCi
186	2 [±] 1 pCi
187-192	NDA
193	2 [±] 1 pCi
194-199	NDA
200	2 [±] 1 pCi
201-202	NDA
203	2 [±] 1 pCi
204-205	NDA
206	2 [±] 1 pCi
207-212	NDA
213	2 [±] 1 pCi
214-216	NDA
217	3 [±] 1 pCi
218	17 [±] 3 pCi
219	10 [±] 3 pCi
220	NDA
221	4 [±] 1 pCi
222-228	NDA
229	45 [±] 1 pCi
230	NDA
231	3 [±] 1 pCi
232	2 [±] 1 pCi
233	47 [±] 6 pCi
234-236	NDA
237	2 [±] 1 pCi
238	NDA
239	5 [±] 2 pCi
240-241	NDA
242	14 [±] 3 pCi
243-256	NDA
257	4 [±] 2 pCi

RESULTS OF RADIATION SURVEY OF TANK FARM

200	225	200	225	200	200	200	200	225	200	200	200
1	2	3	4	5	6	7	8	9	10		
200	200	225	175	200	250	250	250	250	225	200	200
250	250	250	250	200	250	250	250	225	250	250	200
200	200	200	175	225	225	200	250	200	250	250	200
11	12	13	14	15	16	17	18	19	20		
200	225	175	200	200	200	250	250	200	200	200	225
250	225	250	225	225	225	225	250	225	225	200	200
200	225	175	200	150	175	200	226	225	300	200	200
21	22	23	24	25	26	27	28	29	30		
200	225	200	200	200	200	200	175	225	225	200	200
250	250	250	250	250	250	250	250	250	250	250	200
200	200	200	175	225	200	200	225	200	175	200	200
31	32	33	34	35	36	37	38	39	40		
200	200	200	200	200	200	200	200	225	175	200	200
250	225	250	250	250	225	250	250	225	250	250	250
175	200	200	225	225	200	200	200	225	250	250	250
41	42	43	44	45	46	47	48	49	50		
175	200	200	200	200	200	200	200	225	225	250	250
250	250	250	250	250	250	250	250	250	250	250	250
175	225	200	225	225	200	175	250	250	250	250	250
51	52	53	54	55	56	57					
225	200	200	200	200	175	200	250	250	250	250	250
225	250	250	250	250	250	250	250	250	250	250	250
200	175	225	250	200	200	200	225	225	250	250	250
58	59	60	61	62	63	64	65	66			
200	225	200	200	200	225	200	200	200	225	250	250
225	250	250	300	250	250	225	250	250	250	250	225
200	200	200	300	250	250	275	200	200	250	250	250
75	76	73	72	71	70	69	68	67			
200	200	200	200	175	200	200	200	200	250	250	225
250	250	250	250	250	250	250	225	250	200	250	200

** All values are in units of counts per minute measured by the FIDLER survey instrument.

LEVELS OF ACTIVITY OF CONTAMINATED
AREAS IN THE TANK FARM

<u>LOCATION</u>	<u>APPROX AREA (SQ FEET)</u>	<u>INSTRUMENT</u>	<u>ACTIVITY (COUNTS/MINUTE)</u>	
			<u>BEFORE DECONTAMINATION</u>	<u>AFTER DECONTAMINATION</u>
A	10	FIDLER PAC-1S	1000 700	250 NDA
B	5	FIDLER PAC-1S	1000 200	200 NDA
C	12	FIDLER PAC-1S	1000 1000	300 NDA
D	9	FIDLER PAC-1S	2500 5000	250 NDA
E	4	FIDLER PAC-1S	1500 1000	225 NDA
F	8	FIDLER PAC-1S	3000 700	200 NDA
G	8	FIDLER PAC-1S	1000 500	225 NDA
H	12	FIDLER PAC-1S	900 400	200 NDA
I	10	FIDLER PAC-1S	2000 400	300 NDA

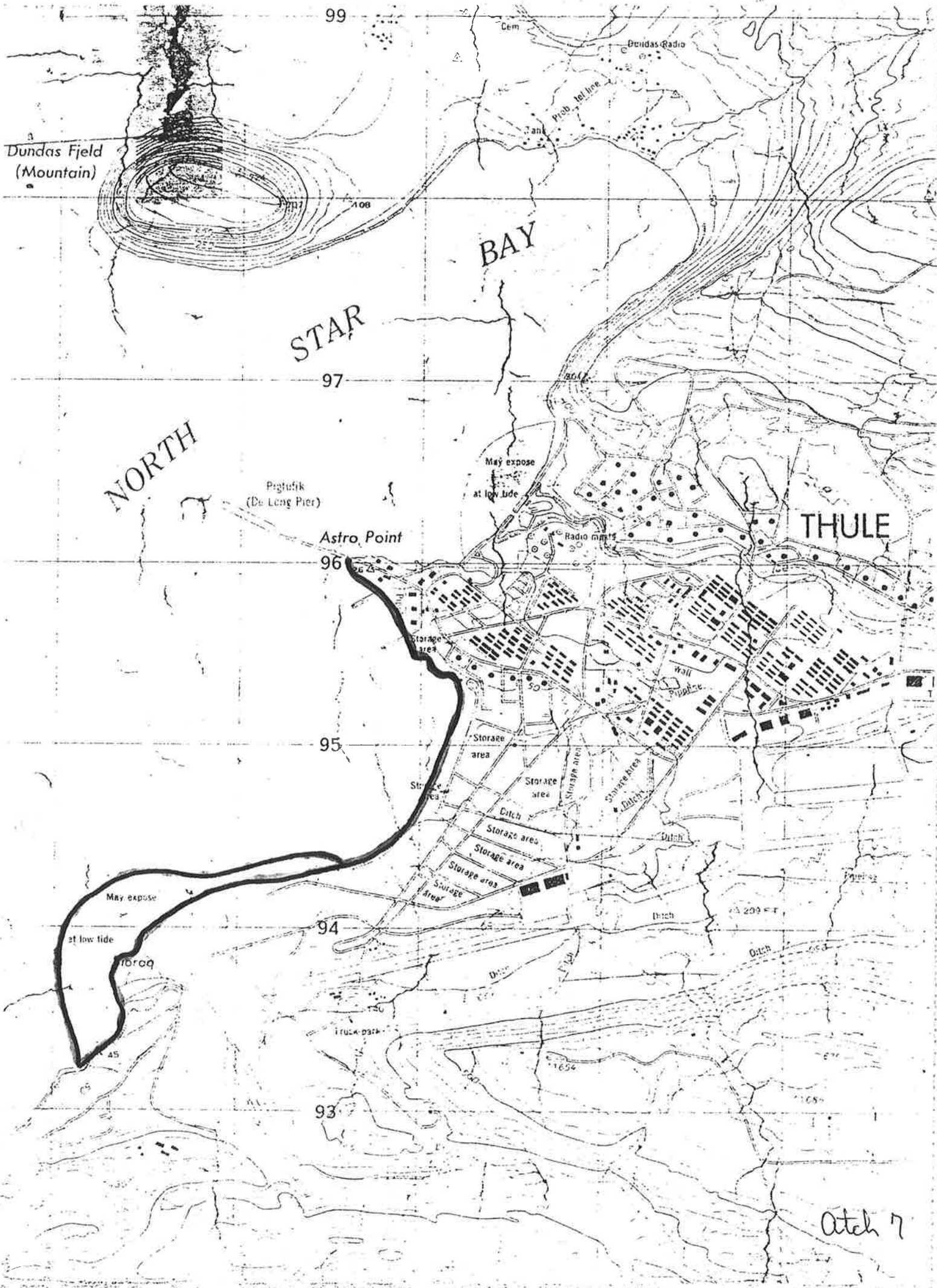
Atch 6

258-264	NDA
265	23 \pm 4 pCi
266	9 \pm 2 pCi
267	3 \pm 1 pCi
268	2 \pm 1 pCi
269-274	NDA
280	48 \pm 6 pCi
281	2 \pm 1 pCi
282	18 \pm 4 pCi
283-284	NDA
285	10 \pm 3 pCi
286-287	NDA
288	6 \pm 2 pCi
289-293	NDA
294	15 \pm 3 pCi
295	5 \pm 2 pCi
296	20 \pm 4 pCi
297-300	NDA
301	2 \pm 1 pCi
302-307	NDA
308	2 \pm 1 pCi
309-315	NDA

*NDA - No detectable activity

**pCi - Picocuries (10^{-12} curies)

NOTE: Swipe sample number designates the number of the R-4360 engine container from which the sample was taken.



Atch 7