THE DEVELOPMENT AND OPERATION OF THE NRTS LAUNDRY

John R. Bonnett

December 1, 1955

PHILLIPS PETROLEUM CO.
ATOMIC ENERGY DIVISION
(UNDER CONTRACT NO. AT (10-1)-205)
IDAHO OPERATIONS OFFICE
U.S. ATOMIC ENERGY COMMISSION

THE DEVELOPMENT AND OPERATION OF THE NRTS LAUNDRY

by

John R. Bonnett

A preliminary proposal for an NRTS Laundry was drafted in January 1952. This proposal presented the estimated cost of constructing a laundry at the National Reactor Testing Station and gave the justification for such construction.

The justification examined three alternate proposals for accomplishing the cleaning of contaminated clothing worn by NRTS operating personnel as follows:

1. Utilization of existing Hanford, Washington facilities.
This proposal was eliminated on the basis of cost. Laundry being sent to be processed and returned from Hanford was estimated to cost 33 cents per pound.

2. Processing by commercial contract.
This proposal was eliminated for legal and psychological reasons.

3. Construction of a laundry at the NRTS.
This proposal was deemed the most economical and desirable. The cost of construction and equipment was estimated at $120,000. In figuring the pounds of laundry to be processed, the amortization of the building and equipment over a five-year period, and the expense of operation, an estimate of 10 cents per pound of processed laundry was made.

Construction began September 5, 1952 on a laundry building at the National Reactor Testing Station. The building was completed in July 1953. The following is a description of the equipment and a report of the operations of the NRTS Laundry from July 6, 1953 to the present time:

Building

The Laundry Building (CF-669) is a 32 by 107 ft. single story, pumice block structure consisting of an 82 by 32 ft. laundry room, and a 25 by 32 ft. boiler room. The laundry room provides space for laundry equipment, a supply room, men's and women's toilet facilities and locker rooms. The boiler room houses the boiler plant, water softening and heating equipment, and compressed air equipment. The boiler plant

provides steam for heating the Laundry building and the Central Facilities Sewage Treatment Plant. It also provides steam for the operation of certain items of laundry equipment.

Equipment

Laundry processing equipment consists of the following:

1. Two stainless steel "Troy" washers with 42 by 54 inch cylinders and rated at 225 lb. capacity. They are manually operated.

2. One stainless steel "Prosperity" washer having a 21 by 28 inch cylinder and rated at 35 lb. capacity. It is manually operated.

3. One stainless steel "Troy" extractor, 30 inches in diameter, rated at 80 lb. dry weight.

4. Three steam heated "Troy" drying tumblers, having 42 by 42 inch cylinders, rated at 80 lb. dry weight.

5. Two stainless steel laundry truck tubs, 26 by 36 by 25 inch, with rubber tired casters. These tubs are used to move damp laundry from washers to extractor.

6. Ten canvas laundry truck baskets with heavy duck baskets on non-rusting frames. They are used to move laundry within the plant.

7. One "Troy" garment press, air operated, steam heated with a 54 inch padded buck and stainless steel head. This press is used to press technicians' uniforms.

8. Miscellaneous items consisting of six stainless steel topped folding tables, mending machine, button sewing machine, and two compartment laundry tub.

9. Monitoring equipment consists of a coverall survey instrument built by AEC-HP personnel, a "Nuclear Instrument" scaler, model No. 166, and a GM meter.

Operation

The operation of the NRTS Laundry is the responsibility of Phillips Petroleum Company. Under the Maintenance Branch, and working in close cooperation with the Health and Safety Branch, the NRTS Laundry handles

all contaminated clothing at the NRTS installations. These include the MTR, CPP, SPERT, EBR, STR, and ANP.

Production was begun in July 1953. The NRTS Laundry was operated with the following personnel:

1. One Laundry Foreman
2. One Washman
3. One Folder
4. One Boiler Operator

The Foreman and One Washman were experienced in commercial laundry operation and were trained by AEC-Health Physics for six weeks in handling and surveying contaminated clothing. The Foreman, in turn, trained the folder, and second washman who was added in September 1954.

Idaho Operations Office, USAEC, requested that no acids be used to decontaminate clothing. This request resulted in an operational procedure designed to (1) clean up the large backlog of slightly contaminated clothing that had accumulated (2) develop ways of cleaning more highly contaminated clothing and (3) process in an orderly manner the day to day requirements of the various installations.

Since it was not known what ranges of contamination would be found on the clothing from the various sources, some tentative grouping had to be made. In order to be on the safe side, and realizing that the personnel were inexperienced, the following grouping was established and each contractor was asked to segregate his clothing into these groups before sending it to the laundry.

Group 1: 0 to 3000 c/m beta-gamma (portable GM meter)
Group 2: 3000 c/m to 7.5 mr/hr beta-gamma
Group 3: over 7.5 mr/hr beta-gamma
Group 4: Alpha alone or with beta-gamma

While it was known that these levels were probably not consistent with the actual amounts of contamination likely to be found at all plants, some grouping was necessary. These groups were chosen because they would give information as to the levels of contamination to be found and would, at the same time, be safe for the laundry personnel to handle.

It was also necessary to establish a release limit on the clothing leaving the laundry. As a coverall monitor was still in the process of construction a "scaler" was used to check all garments. The release limit was set at 3000 c/m/2 sq. in. This limit was lower than necessary for adequate protection to the wearer of the clothing but would give valuable information as to what percentage of the clothing could be decontaminated and released at this level.

Laundering was started with a standard commercial Formula A (See Exhibit B) for white coveralls. This formula was found to be ineffective in decontamination. Formula B, suggested by Foster D. Snell and Associates, was tried and, on groups 1 and 2 above, gave consistently good results. However, Formula B did not perform very well on Group 3.

In order to clean up the large backlog of contaminated clothing on hand and to prevent the necessity of the purchase of additional new clothing by the various contractors it became necessary to pre-monitor all clothing and wash only that in groups 1 and 2. It was found that about 70 per cent of this clothing fell into Group 2 and that decontamination to 3000 c/m/2 sq. in. was not practical. Operations continued with this grouping and the release limit was raised to 3 mr/hr. This backlog, along with daily usage, was worked on until the latter part of August 1953.

At this time it became clear that a more efficient formula would have to be developed and a more realistic grouping of contaminated clothing made. In order to achieve these two points a testing program was begun that developed Formulas C and D and finally Formula E. Formula E was devised with the thought that contamination would be introduced on the garment in many forms and in all ranges of the PH scale. This formula does very well in all cases involving contamination up to 40 mr/hr and in many cases well over that.

In a series of tests conducted in November 1953 on swatches of material containing a wide range of fission products laundering successfully removed 98 per cent or more of the contamination. The original readings of these contaminated patches ranged from 150 mr/hr to 25 R/Hr. See Table I.

TABLE I

Patch No.	beta-gamma rep/hr	gamma r/hr	Per cent removal	Activity after washing
A - 1	1.600	.125	97.365 & 98.800	42.0 mr & 1.5 mr
2	.150	**	99.000	1.5 mr
3	.300	.075	99.433 & 99.867	1.7 mr & 0.1
4*	1.250	**	96.080	48.0 mr
B - 1	10.000	.750	99.000 & 100.000	100.0 mr & 2.5 mr
2	12.000	.750	99.167 & 99.733	100.0 mr & 2.0 mr
3*	5.000	.350	98.600 & 99.700	70.0 mr & 1.0 mr
4	1.500	.075	99.333 & 99.667	10.0 mr & 0
C - 1	.750	.075	99.500 & 100.000	4.0 mr & 0
2	1.000	.025	99.000 & 98.000	10.0 mr & 0.5 mr
3	.250	**	99.600	1.0 mr
4	.100	**	99.500	0.5 mr
D - 1	1.600	.125	98.625 & 99.600	22.0 mr & 0.50
2	25.000	.040	99.998 & 99.375	8.0 mr & 0.25
3*	.750	.040	99.200 & 100.000	6.0 mr & 0

*Washed with Formula E and substituting Calgonite for Versene in pounds.
**No Gamma

Rewash of above samples

Patch No.	Per cent removal of remaining contamination	Activity removal
A - 1	60%	42.0 mr down to 26.0 mr
C - 4	80%	.5 mr down to .1 mr
D - 2	75%	8.0 mr down to 2.0 mr

The third wash of samples A-1, C-4, and D-2 showed no additional removal of contamination.

These patches were then sent to the CPP for chemical analysis and the remaining material was found to be: Ruthenium 50%, Total Rare Earths 25%, Zirconium and Niobium 2%, Unaccounted for 23%.

In September 1953 wash groupings were changed to the following:

Group 1: 0 - 10 mr/hr beta-gamma
Group 2: 10 - 100 mr/hr beta-gamma
Group 3: 100 mr/hr beta-gamma or higher
Group 4: Alpha alone or with beta-gamma

With this grouping there is at this time 70 per cent of the clothing in Group 1, 28 per cent in Group 2, 2 per cent in Group 3, and a negligible amount in Group 4.

The release limit from the laundry was also raised to 7.5 mr/hr for a garment total. This is obtained by the use of the coverall monitor. On gloves, shoe covers and caps 1 mr/hr is the release limit. No alpha emiters are released.

To date it has not been possible to decontaminate all spots on all garments and those that could not be removed are cut out and a patch sewn on. This has proved to be a good practice because the average garment has only one or two "hot" spots.

Formula F was developed in an effort to cut the cost of supplies. However, this has not proved a success and is not being used. The laundry has been using Formula C on all clothing under 10 mr/hr and Formula E on all clothing over 10 mr/hr. Group 4 clothing is washed separately, the formula used is dependent on the amount of beta-gamma. The testing program is continuing and a change to formula G is now being made. This formula appears more efficient and will cut our supply cost by 50 per cent.

It is interesting to note that after two years of continuous operation no build-up of contamination in any machine has been found, nor has any garment been found with a background over 300 c/m/2 sq. in., except those which have been repeatedly highly contaminated.

COSTS (See Exhibit A)

Wages

Total annual wages are approximately $20,000.00

Supplies

1.	Versene	$0.83 per pound
2.	Tide	0.20 per pound
3.	Sour (Erusto Salts)	0.25 per pound
4.	Turco T-4182-A	0.33 per pound

The yearly cost of supplies is about $6000.00.

PRODUCTION (See Exhibit A)

The weekly average production is 4500 pounds. The average cost per pound is approximately 12 cents. All laundry is rough dried and folded with the exception of technicians' uniforms. All clothing which was washed in groups 2, 3 and 4 is individually monitored. Clothing in group 1 is spot-checked with only gloves and shoe covers individually monitored.

EXHIBIT A — CHART OF PRODUCTION VERSUS COSTS.
FISCAL YEAR 1954

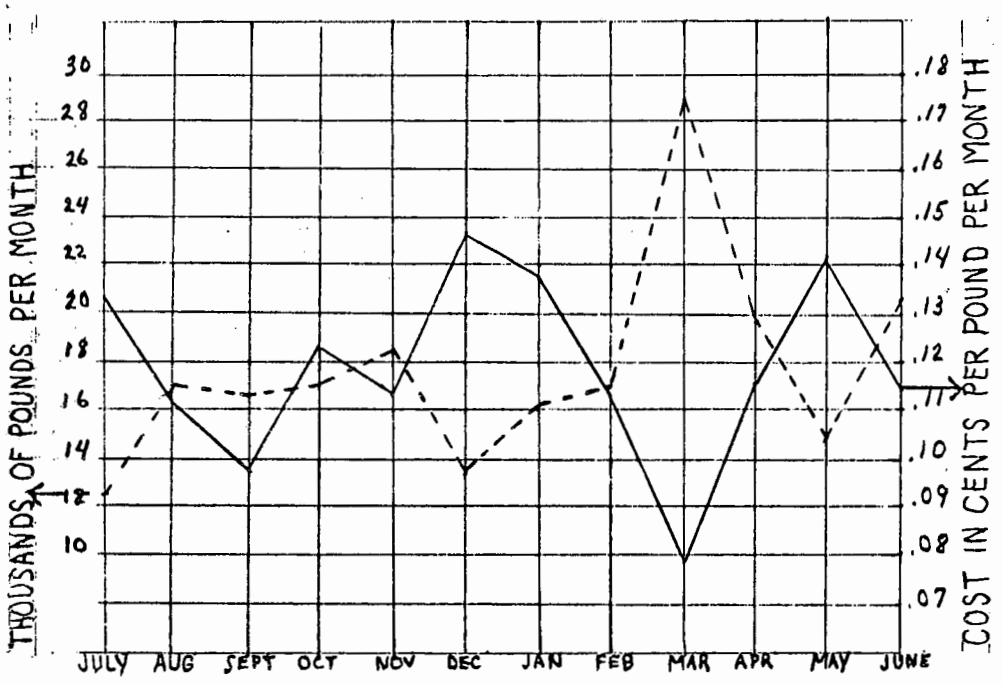

EXHIBIT B

Formulas

The following formulas are based on a 150 pound load of clothes and using a 42 by 54 inch washer.

Formula A

Operation	Temperature	Time/Minutes	Water Inches
1. Break 1 lb. Escolloid	180	10	6
2. Flush	180	3	10
3. Flush	180	3	10
4. Suds 1 lb. Escolloid 1 lb. B. Soap	180	10	5
5. Suds ½ lb. Escolloid ½ lb. B. Soap	180	10	5
6. Suds ¼ lb. B. Soap 1½ qt. 1% Bleach	160	10	5
7. Rinse	160	3	10
8. Rinse	160	3	10
9. Rinse	160	3	10
10. Rinse	140	3	10
11. Rinse	Cold	3	10
12. Sour and Blue	Cold	3 & 5	5 & 10

Formula B

Operation	Temperature	Time/Minutes	Water Inches
1. Suds 1 lb. Tide 2 lb. Versene	190	10	5
2. Flush	190	10	5
3. Suds ½ lb. Tide 1 lb. Versene 1½ qt. Bleach	160	10	5
4. Rinse	180	3	10
5. Rinse	160	3	10
6. Rinse	160	3	10
7. Rinse	150	3	10
8. Rinse	Cold	3	10
9. Sour and Blue	Cold	3 & 5	5 & 10

EXHIBIT B

Formula C

Operation	Temperature	Time/Minutes	Water Inches
1. Tide 1 lb. Versene 4 lb.	Cold	10	5
2. Flush	180	5	10
3. Tide ½ lb. Versene 2 lb. 1½ qt. Bleach	160	10	5
4. Rinse	180	3	10
5. Rinse	180	3	10
6. Rinse	180	3	10
7. Rinse	160	3	10
8. Rinse	160	3	10
9. Rinse	Cold	3	10
10. Sour and Blue	Cold	3 & 5	5 & 10

Formula D

Operation	Temperature	Time/Minutes	Water Inches
1. Suds 6 lb. Sour 1 lb. Tide	90	8	5
2. Flush	90	3	10
3. Suds 6 lb. Versene 1 lb. Tide	100	8	5
4. Flush	110	3	10
5. Suds 4 lb. Versane ½ lb. Tide	120	8	5
6. Rinse	120	3	10
7. Rinse	120	3	10
8. Rinse	120	3	10
9. Rinse	120	3	10
10. Sour and Blue	Cold	3 & 5	5 & 10

EXHIBIT B

Formula E

Operation	Temperature	Time/Minutes	Water Inches
1. Suds 3 lb. Sour 1 lb. Tide	90	8	5
2. Flush	90	3	10
3. Suds 6 lb. Versene 1 lb. Tide	100	8	5
4. Flush	110	3	10
5. Suds 4 lb. Versene ½ lb. Tide	120	8	5
6. Flush	140	3	10
7. Suds ½ lb. Tide 1½ qt. Bleach	160	8	5
8. Rinse	160	4	10
9. Rinse	140	3	10
10. Rinse	140	3	10
11. Rinse	140	3	10
12. Sour and Blue	Cold	3 & 5	5 & 10

Note: Soap in operations No. 5 and No. 7 may be omitted if clothes are not dirty.

Formula F

Operation	Temperature	Time/Minutes	Water Inches
1. Suds 1 lb. Tide	90	8	4
2. Flush	90	3	10
3. Suds Versene 4 lb.	90	8	4
4. Flush	150	3	10
5. Suds Calgonite 3 lb. 1½ qt. Bleach	160	8	4
6. Rinse	150	3	10
7. Rinse	140	3	10
8. Rinse	130	3	10
9. Rinse	90	3	10
10. Sour and Blue	90	3 & 5	5 & 10

EXHIBIT B

Formula G

Operation	Temperature	Time/Minutes	Water Inches
1. Suds 10 lbs. T-4182-A	180	10	5
2. Bleach 1½ qt.	160	10	5
3. Rinse	140	3	10
4. Rinse until clear	130	3	12
5. Sour and Blue	90	3 & 5	5 & 10

Note: T-4182-A manufactured by Turco Products, Incorporated, Los Angeles, California.

ACKNOWLEDGMENTS

The author wishes to express sincere appreciation for valuable assistance given during the tests and the writing of this report to J. W. McCaslin and R. E. Hayden, Health and Safety Section.