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R. Nilson

April 26, 1967

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April 26, 1967

U. S. Atomic Energy Commission
Richland Operations Office
Richland, Washington

Attention: Mr. M. R. Schneller, Director
Office of Advanced Planning

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Gentlemen:

SPECIAL DISARMAMENT STUDY

We have updated our previous study¹ on the cost of shutting down and later starting up the Hanford production complex. It is our understanding that these studies are to be used for disarmament study purposes. Our latest estimate is approximately double our previous estimate and is based on several entirely new assumptions.

We are also including comments on two aspects, other than cost, which we consider to be of great importance. One is the impact of a complete shutdown on the Tri-Cities community. The other is the effect on Battelle's Pacific Northwest Laboratory, which is now heavily supported by non-02 programs. These latter comments have been prepared by B. B. Field, Director of Business Research and Area Diversification, Douglas United Nuclear, and Dr. R. S. Paul, Associate Director, Battelle Memorial Institute, Pacific Northwest Laboratory.

Our study encompasses six special shutdown-startup cases. One set of three cases assumes a shutdown of three years; the other set assumes the reactors have been down for a period of five years (from shutdown of the last reactor to startup of the first conventional reactor in the series). Within each of the above mentioned sets there are three cases assuming the return of five, six, or seven reactors to weapons production. The sixth and seventh reactors are D and DR respectively. N Reactor is assumed transferred to WPPSS instead of shut down, and consequently is available for recapture earlier than the conventional reactors.

The shutdown schedule is shown in Table IA. The dates, except for the shut down of D Reactor, were picked arbitrarily and can be moved ahead so long as the intervals are kept the same. There is one exception to this generalization. The sludge program at the B Plant will end in 1973 and then waste management will be on a current basis. Thus, the operation of B Plant depends on the shutdown timing. In the cases studied, based on a 1968 shutdown date, the B Plant and other waste-management facilities operate throughout the shutdown periods.

¹Staff Advanced Operational Planning Group, "Monthly Report - July, 1966," DUN-AOP-3, (Secret).

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TABLE IASHUTDOWN SCHEDULE

D Reactor shutdown	July 1, 1967
Announcement of reactor shutdown schedule	January 1, 1968
N Reactor transferred to WPPSS	July 1, 1968
B Reactor shutdown	July 1, 1968
C Reactor shutdown	October 1, 1968
KE Reactor shutdown	January 1, 1969
KW Reactor shutdown	April 1, 1969
Purex shutdown	November 1, 1969
UO ₃ shutdown	January 1, 1970
Metal Reduction shutdown	January 1, 1970
Pu Reclamation shutdown	July 1, 1970*
B-Plant and those facilities associated with Waste Management	Continue to operate

The startup schedule is shown in Table IB. In the seven-reactor subcases, the Redox plant is returned to operation from an abandoned status.

The assumptions for the study are given below. Where there is a difference from the earlier study, the difference is noted.

General Assumptions

1. No provision has been made for escalation.
2. A contingency of 20 percent has been added to all costs. This represents a considerable increase from previous studies.
3. Shutdown costs in all cases begin with the July, 1967, shutdown of D Reactor. Standby costs, however, include DR Reactor.
4. Shutdown costs are substantially higher than previously reported. They reflect the psychological effect on manpower productivity under complete

*Not shut down in the three-year cases.

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TABLE IB
STARTUP SCHEDULE

	<u>3-Year Cases</u>	<u>5-Year Cases</u>
Announcement of reactor startup schedule; contractors selected and top management, relations, and financial personnel available	July 1, 1970	July 1, 1972
N Reactor recaptured	July 1, 1970	July 1, 1972
Intermediate management, and key technical support and procurement personnel available	October 1, 1970	October 1, 1972
Begin engineering review and operator training	October 1, 1970	October 1, 1972
First loading of cooled metal from N Reactor ready to process in separations facilities	March 1, 1971	March 1, 1973
N Reactor fuels area at full production capability	April 1, 1971	April 1, 1973
Conventional reactors' fuels area in production	July 1, 1971	July 1, 1973
Purex ready to process	July 1, 1971	July 1, 1973
Metal Reduction facility ready to process	July 1, 1971	July 1, 1973
UO ₃ Plant ready to process	September 1, 1971	September 1, 1973
Pu Reclamation facility ready to process	Not shut down	September 1, 1973
First conventional reactor loading of fuel elements ready to be charged	January 1, 1972	January 1, 1974
KW Reactor startup	April 1, 1972	April 1, 1974
KE Reactor startup	July 1, 1972	July 1, 1974
C Reactor startup	October 1, 1972	October 1, 1974
B Reactor startup	January 1, 1973	January 1, 1975
D Reactor startup	April 1, 1973	April 1, 1975
First loading of cooled metal from conventional reactors ready to process in separations facilities	April 1, 1973	April 1, 1975
DR Reactor startup	July 1, 1973	July 1, 1975
Redox ready to process	October 1, 1973	October 1, 1975

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shutdown conditions based on prior managerial experience under these conditions.

5. No special shutdown planning or advance documentation to assist in re-starting the reactors will be performed.
6. Materials and equipment that would jeopardize the standby requirement of an 18-month startup will not be excessed at shutdown. Generally, all supplies and chemicals would be depleted or excessed at shutdown and must be replenished. Costs are included for replacing or restoring equipment housed in facilities that are not maintained in standby condition, such as lathes and other shop material.
7. All supporting buildings and facilities, shops, office, buildings, etc. are restored to preshutdown condition from an abandoned status and are not covered by the standby costs.
8. The Hanford complex will be returned to 02 production on a segmented contractor basis comparable to the present organization. Production contractors will be able to purchase services from service contractors. Operating and maintenance personnel will handle operating type problems and service contractors will handle significant nonroutine startup modifications, revisions, etc.
9. Startup costs reflect a temporary excess of manpower during the early years after resumption of operations. At the time of startup, the number of operating personnel was assumed to be 30 percent above normal and the number of engineering and technical personnel at 25 percent above normal. This overstaffing declines linearly to normal levels over a period of three years. No overstaffing was assumed in administrative personnel. Earlier studies assumed only very limited overstaffing during the initial period after startup.
10. Startup costs reflect premium salaries of 20 percent above the normal level to attract a small nucleus of experienced manpower and to recruit and relocate the remainder of the employees. Sufficient experienced personnel will be available to provide training to the nonexperienced. In previous studies a much lower salary premium was assumed.
11. In general, all equipment and facilities will be restored to the operating condition which existed immediately prior to shutdown. Exceptions to this assumption are noted later. After startup, process development (R&D) would continue essentially at the preshutdown level. It is assumed that no new processing capability will be required upon startup.
12. At startup, uranium elements will be available from offsite sources when required.

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13. Material and equipment purchases will be made on a "defense priority" basis that will permit meeting the startup schedule (Table IB). Startup costs reflect premium material and equipment costs on certain purchases where early delivery is critical.
14. Startup costs include expenditures required to replace movable equipment, supplies, and spare parts of operating contractors and support services contractors, where such supplies and equipment were excessed at shutdown. CSC replacement costs include the cost of a new computer and replacement of necessary computer systems. ITT/FSS costs include replacement of excessed furniture, vehicles, heavy equipment, supplies, and inventories. None of these items were included in earlier estimates of startup costs.
15. Uranium fuel cost is not included in startup costs.
16. Adequate electricity will be available at time of startup and a contract increasing firm power in required increments will be negotiated at existing costs. No penalty is expected.

Reactor Assumptions

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1. N Reactor returns to weapons production during the first quarter after the startup announcement date. The rise to stretch power level is initiated in the third quarter and fully achieved in the fourth.
2. A standby load of N-Reactor fuel will be preproduced. Materials including uranium billets sufficient for an additional reactor fuel load will be stockpiled after the transfer. Cost of standby load is not included.
3. Conventional reactors are started up as soon as possible with quarter intervals after the first reactor.
4. Three months are required to reach the operating levels in the conventional reactors. This will allow for metal quality evaluation and operator proficiency development.
5. All aluminum tubes would be replaced.
6. All RTD's and thermocouples would be replaced in conventional reactors.
7. Provision has been made for general rehabilitation of pumps and motors. However, it is assumed that no major alignment nor bearing replacement will be required at startup time.
8. Tubing in the boiler houses will be deteriorated to the extent of requiring significant retubing and rebricking. Earlier studies did not assume this degree of deterioration.
9. Reactor seals and safety and control rod seals will be replaced. This item was omitted in previous estimates.

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10. Funds are provided for correcting deterioration of the effluent system.
11. Instrumentation will require maintenance and costs have been included for updating to present technology. No specific provision was made for these costs in earlier studies.
12. Costs are included in appropriate cases for the upgrading of DR Reactor to meet nuclear and physical safety requirements currently existing in other reactors.
13. There will be no additional channel enlargement of the conventional reactors prior to restart.

Fuels Assumptions

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1. Startup costs reflect a premium of 10 percent on procurement of supplies and materials in the first year.
2. A 25 percent premium is assumed for the first year in which aluminum components are delivered. This is necessary to compensate for small order quantities during the year in which necessary dies and tools are made.

Separations Assumptions

1. B Plant will be operating on sludge from the waste tanks throughout the standby period. No shutdown or startup costs are included in these cases for waste management. Waste management manpower levels remain constant.
2. Redox, which was assumed abandoned when Purex was placed on standby, returns to operating status in the seven-reactor startup cases.
3. During the period of separations plant standby, the condition and operability of the pumps, agitators, rotameters and other similar equipment will be tested once every two weeks for circulating water leakage through the system. This testing procedure will take approximately two days. Any leakage or inoperable equipment detected during the testing will be corrected prior to the next test.

The shutdown-startup costs for the six cases studied are detailed in Table II. We feel that the costs shown are as realistic as we can make them. We assume that a critical defense need would exist at the time the plants would be required to come back into operation. Thus, the largest costs are those for startup training and operation which reflect overstaffing, premium pay, and other extraordinary costs assumed necessary to bring the plants back into operation on an accelerated schedule. The startup construction costs are moderate and reflect minimum deterioration of equipment during the period of shutdown. The dry, clean air in eastern Washington is an important factor in preservation of materials and observations of equipment in plants currently in standby status show very little sign of deterioration.

TABLE II
SHUTDOWN-STARTUP COSTS

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(in millions)	<u>3 Year Shutdown</u>			<u>5 Year Shutdown</u>		
	<u>Reactors to Start Up</u>			<u>Reactors to Start Up</u>		
	<u>5</u>	<u>6</u>	<u>7</u>	<u>5</u>	<u>6</u>	<u>7</u>
<u>Shutdown Costs</u>						
DUN	\$ 6.9	\$ 6.9	\$ 6.9	\$ 6.9	\$ 6.9	\$ 6.9
GE	.3	.3	.3	.3	.3	.3
Isochem	11.3	11.3	11.3	12.0	12.0	12.0
Subtotal	\$ 18.5	\$ 18.5	\$ 18.5	\$ 19.2	\$ 19.2	\$ 19.2
Contingency	3.7	3.7	3.7	3.9	3.9	3.9
Total	\$ 22.2	\$ 22.2	\$ 22.2	\$ 23.1	\$ 23.1	\$ 23.1
<u>Standby Costs</u>						
DUN	\$ 1.7	\$ 1.7	\$ 1.8	\$ 2.6	\$ 2.6	\$ 2.6
GE	.4	.4	.4	.8	.8	.8
Isochem	.4	.4	.4	9.7	9.7	9.8
Subtotal	\$ 2.5	\$ 2.5	\$ 2.6	\$ 13.1	\$ 13.1	\$ 13.2
Contingency	.5	.5	.5	2.6	2.6	2.6
Total	\$ 3.0	\$ 3.0	\$ 3.1	\$ 15.7	\$ 15.7	\$ 15.8
<u>Startup Costs</u>						
DUN						
Startup Construction	\$ 15.1	\$ 18.5	\$ 21.8	\$ 20.6	\$ 25.0	\$ 29.5
Training and Operating	36.3	41.3	46.4	36.3	41.3	46.4
	\$ 51.4	\$ 59.8	\$ 68.2	\$ 56.9	\$ 66.3	\$ 75.9
GE	\$ 1.5	\$ 1.5	\$ 1.5	\$ 1.5	\$ 1.5	\$ 1.5
Isochem						
Startup Construction	\$ 6.0	\$ 6.0	\$ 8.9	\$ 7.5	\$ 7.5	\$ 11.5
Training and Operating	40.0	40.0	49.8	43.1	43.1	53.1
	\$ 46.0	\$ 46.0	\$ 58.7	\$ 50.6	\$ 50.6	\$ 64.6
CSC	\$ 3.2	\$ 3.2	\$ 3.2	\$ 3.2	\$ 3.2	\$ 3.2
ITT-FSS	\$ 16.5	\$ 16.5	\$ 16.5	\$ 16.5	\$ 16.5	\$ 16.5
Subtotal	\$118.6	\$127.0	\$148.1	\$128.7	\$138.1	\$161.6
Contingency	23.7	25.4	29.6	25.7	27.6	32.3
Total	\$142.3	\$152.4	\$177.7	\$154.4	\$165.7	\$193.9
<u>Grand Total</u>	\$167.5	\$177.6	\$203.0	\$193.2	\$204.5	\$232.9

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We all recognize that a special situation exists at Hanford in that 1) significant non-02 AEC work is in progress, 2) a major 04 facility, the FFTF, is to be constructed, and 3) diversification activities have started involving private investments of the operating contractors. Thus, the "costs" associated with shutting down and starting up the production portion of the site are not restricted to those just discussed. The broader picture involves the future of a significant cooperative program between the AEC and private enterprise in the Tri-Cities area. To not recognize and comment on these broader aspects would present a distorted picture. Discussions of the impacts on the Pacific Northwest Laboratory and the Tri-Cities community are therefore appended.

Very truly yours,

R. Nilson, Coordinator
Advanced Operational Planning Group

RN:md

Concurrence:

W. J. Dowis
General Electric Company

A. E. Smith
Isochem Inc.

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APPENDIX I

COMMUNITY IMPACT

The impact on the Tri-City community of either the three-year or the five-year cases will be the same, for that impact is a consequence of the initial shut-down phase, not the subsequent restart phase.

To evaluate the impact of a plant-wide shutdown on the community, one must consider not only the direct effect of lost jobs, but also the indirect effect on the local economy. The latter will be influenced by the state of local development at the time of the shutdown. The postulated shutdown cycle begins in January, 1968, with a public announcement. The announcement states that all Hanford reactors will be shut down, except NPR, which will be used only for power production under WPPSS management, and specifies the year and a quarter time phasing of the shutdown of each reactor. Plant employment at the time will be about 7170, and would drop to about 3530 over the period January, 1968, to April, 1969. Thus, 3640 jobs will be wiped out at Hanford. These numbers refer only to AEC supported jobs, not to the private work undertaken by Hanford contractors.

The principal impact questions are:

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1. To what extent will the loss of these basic (to the community) jobs be offset by other basic jobs?
2. How many secondary jobs will be lost as a consequence of the net loss of basic jobs?
3. What other significant indirect community consequences will follow?

There are three sources of new basic jobs which might offset the losses. First, new jobs can be created by the AEC (or other governmental agencies) bringing to the Hanford area new programs. An example is the FFTF which will eventually offset the losses from the shutdown of D Reactor. Second, new jobs can be created by AEC contractors or contractor parent companies through their private diversification efforts. Third, some local industries such as food processing which are basic and not tied to Hanford activities would be expected to expand in a normal way. On the other hand, contract construction employment (excluding AEC-sponsored work) has shown declines due principally to the gradual completion of nearby dam construction work.

New basic jobs, not related to AEC and its contractors, are estimated to increase at the rate of 60 per year. This may be increased if new non-Hanford related industry is brought into the area. But success in this field is partly related to maintaining the Tri-Cities as a major growth area. The plant shutdown postulated in this study will destroy the growth image of the community. Thus, one is left with the normal growth potential of 60 basic jobs per year.

These jobs can be supplemented by the diversification efforts of AEC contractors. The greatest bulk of basic jobs created (or to be created) by contractor diversification are one-shot situations. More than half of these will have been created prior to 1968 as an offset to earlier reactor shutdowns. The pending shutdown of D Reactor (during 1967) will largely offset the balance of these one-shot diversification efforts and part of the increase due to FFTF. What will, or can, happen is a small rate of increase in contractor private jobs after all those one shot jobs have been created. This should yield an annual increase of about 70 basic jobs (including normal Battelle expansion).

Thus, we can expect an annual increase of 130 jobs per year from these sources.

The operation of FFTF will yield a one-shot increase of about 350 jobs during the postulated shutdown period. But, as pointed out above, this is partly offset by the D-Reactor shutdown. The construction of FFTF will yield only a temporary rise in basic jobs. Since this transient will disappear prior to the postulated restart of reactors, and since the restart will not be announced when the shutdown is announced, the impact of this construction activity will be negligible.

In total, therefore, we can measure the direct impact of the shutdown in the following terms:

Plant Shutdown Effect	3640 jobs lost
FFTF Offset	<u>250 jobs gained</u>
Net Effect	3390 jobs lost
Normal Job Growth: 2 Years Jan., 1968, to Jan., 1970	260 jobs gained
Net Effect by Jan., 1970	<u><u>3130 jobs lost</u></u>

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In other words, by nine months after the last reactor is shut down, the Tri-Cities will have lost a net of 3130 basic jobs.

The loss of any significant number of basic jobs in a community has a depressing effect on secondary jobs. For the Tri-City area, the current base ratio is 1 to 2.2. This means that the 3130 basic jobs lost will result in 6890 total (basic plus secondary) jobs lost. These jobs now directly support 18,500 men, women, and children residing in the Tri-Cities. With the postulated job losses, those 18,500 people would also be lost to the area.

In the City of Richland, where the bulk of Hanford people live, the impact would be stronger. Approximately 65 percent of all Hanford contractor employees live in Richland. On the other hand, Richland offers virtually no other basic employment opportunities.

The 6890 jobs lost represent about 35 percent of all covered employment in Benton and Franklin counties, and 39 percent of the covered employment in the three cities alone. Thus, the loss of these jobs means a breakdown in Richland's economy and a major blow to the rest of the Tri-City community. Some of the other (i.e., nonjob) consequences also raise critical questions.

In Richland alone, 658 new single family homes have been built since 1961 at a cost of over \$15 million. What will happen to the housing market? How will the unemployed be able to sell (or even rent) their houses so they can move to other cities to get jobs? If they don't move, how can they keep up mortgage payments? What happens to the heavy mortgages of churches that have expanded during the past five to six years when their parishioners leave? What happens to the local business community? What happens to local government and educational facilities when their incomes drop and they are unable to pay off their bonded indebtedness? Richland is about to undertake a \$2.3 million public building program--financed in part by debt.

One of the major new local improvements about to start is a regional shopping center (600,000 square feet). This center is a necessary element in aiding community growth. The land will be cleared and prepared, but construction will not have started by January, 1968. If the timing assumed in the shutdowns were instituted, the shutdown announcement in January, 1968, would kill that shopping center. With it would disappear a potential of 400 new jobs plus the local services needed to make the community an attraction for new industry.

In summary, if the assumed shutdown were effected, the resultant loss of 3130 basic jobs will bring about the loss of a. additional 3760 secondary jobs, will critically weaken the economy of the Tri-Cities as a whole, and virtually destroy that of Richland. It will create havoc in the real estate market, saddling thousands of families with unsalable homes and with the need to sell them. It will place a major financial burden on churches, school districts, and local governments.

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APPENDIX IIIMPACT ON PNL OF SHUTDOWN OF HANFORD PRODUCTION PLANT
AND LATER STARTUP

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Impact of Shutdowns

The shutdown of the production plants would have three major impacts upon the Laboratory: (1) There would be a loss of R&D and technical support business now performed for the plant. (2) Certain costs for operating and maintaining facilities would increase. (3) The business and social climate of the community might reduce the viability of the Laboratory for continuing its other AEC businesses and its non-AEC R&D business development.

The current portion of PNL's business in support of the production plants is about \$6,000,000 per year, or about 13 percent of the total volume. This represents about 300 staff members who would have to be removed from the force or diverted to other assignments. The availability of other assignments is dependent upon factors which are unknown at this time.

PNL now is supported by FSS through such services as stores, electrical distribution, laundry, riggers, transportation, road and rail maintenance, patrol, etc. It is assumed that these services would still be available from some other contractor but their costs would be increased. PNL would have to take over operation of the 200 Area powerhouse, install package boilers for 189-D and facilities in 200-W, install electric heat in 209-E, and operate or have operated pumps at 100-B or 100-D to supply water to laboratory facilities in the 200 Areas. It is assumed that PNL activities at 100-K and 100-B-C would be closed down. These actions would require an initial capital investment of about \$500,000 and incremental annual operating costs of \$1,750,000 to keep the remaining AEC laboratory facilities in operation.

These increases in operational costs would make Battelle-Northwest less competitive in developing diversification business. The magnitude of this effect is highly dependent upon the level of development of the non-AEC business when the shutdowns occur. The greater the level, the less serious the effect. In a few cases the elimination of production R&D would make it difficult to operate certain facilities which are used in part for non-production research. A prime example is the 306 Building Metallurgical Development Laboratory. These types of problems and technical staff problems could be substantially alleviated by a deliberate AEC policy to use these resources for more civilian-oriented atomic energy work. Again the timing is a crucial factor; shutdowns concurrent with construction and startup of FFTF would not be as detrimental to PNL viability.

The effect of a depressed community upon retention, recruitment, and morale of staff is difficult to assess. It would depend in large measure upon the technical employment job market nation-wide. Qualitatively it seems certain that it would be more difficult to maintain the viability of staff under the shutdown situation than in a vigorous economic community environment. Some schools and stores would close and housing values would decrease. The

attitude of Battelle staff members toward remaining in the community would be influenced by their pessimism or optimism regarding the longer-ranged prospects for community recovery and growth. Here again, if the Hanford diversification program has had time to gain sufficient momentum, pessimism would be minimized.

Impact of Subsequent Startups

Presumably startup would occur under a state of national emergency. The Laboratory would be the primary initial source of technical manpower to support reactivation of the plant. This activity would have highest priority. The associated incremental costs for supplies, extra staffing and rehabilitation of supporting laboratory facilities are estimated to be \$1-2,000,000. This figure appears to be rather insensitive to whether the startup occurs three or five years after shutdown. These incremental costs do not include the considerably larger costs by the production operation for R&D and other technical services from PNL in connection with reactivation of the production plant.

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