VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

W. L. PROFFITT
SENIOR VICE PRESIDENT

December 2, 1977

Mr. Edson G. Case, Acting Director
Office of Nuclear Reactor Regulation
Attn: Mr. Robert W. Reid, Chief
Operating Reactors Branch No. 4
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Serial No. 532
PO&M/HSM:kbo
Docket Nos 50-280
50-281
License Nos. DPR-32
DPR-37

Dear Mr. Case:

Attached herewith is 40 copies of additional information concerning the steam generator replacement at Surry Power Station. This information is being submitted as revision 1 to the document entitled, "Steam Generator Program, Surry Power Station, Unit Nos. 1 and 2" enclosed with our letter of August 17, 1977, Serial No. 351. The sections being submitted primarily discuss personnel radiation exposure and environmental concerns.

Please note that in accordance with your letter of October 21, 1977, this submittal includes a notarial statement which also applies to our earlier submittal of August 17, 1977.

If you have any questions or comments on this material or the material submitted on August 17, 1977, we would be pleased to meet with your staff at their convenience to discuss them.

Very truly yours,

W. L. Proffitt
Senior Vice President

Attachment

cc: Mr. James P. O'Reilly, Director
Region II
Office of Inspection & Enforcement

(SEAL)

Attest:

G. P. Morecock

G. P. Morecock, Assistant Secretary

COMMONWEALTH OF VIRGINIA)
) S.S.
CITY OF RICHMOND)

Before me, Robert M. Neil, a Notary Public, in and for the City and Commonwealth aforesaid, on the 2nd day of December, 1977, personally appeared S. C. Brown, Jr. and G. P. Morecock, who being duly sworn, made oath and said (1) that they are Vice President-Power Station Engineering and Construction and Assistant Secretary, respectively, of the Virginia Electric and Power Company, (2) that they are duly authorized to execute and file the foregoing Amendment in behalf of that Company, and (3) that the statements in the Amendment, including the letter of August 17, 1977, Serial No. 351, are true to the best of their knowledge and belief.

Given under my hand and notarial seal this 2nd day of December, 1977.

My Commission expires January 20, 1981.

Robert M. Neil

Robert M. Neil
Notary Public

(SEAL)

STEAM GENERATOR REPAIR PROGRAM
FOR THE SURRY POWER STATION
UNIT NOS. 1 AND 2

REVISION 1

1. Record the copy number and assignees name on the new assignment sheet.

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SURRY POWER STATION
STEAM GENERATOR PROJECT

COPY NO.

THIS COPY OF THE STEAM GENERATOR REPAIR PROGRAM FOR THE SURRY POWER STATION UNIT NOS. 1 AND 2 HAS BEEN ASSIGNED TO

This Manual is the property of the Virginia Electric and Power Company, and shall be returned to the Project Engineer, Steam Generator Project Office, in the event the employee terminates his employment is reassigned outside his present location, or upon request of the Project Engineer.

This Manual may not be reproduced, in part or whole, without the written permission of the Virginia Electric and Power Company. All requests should be directed to the Project Engineer, Steam Generator Project.

This Manual shall be maintained and updated by the person whose name appears above as revisions are issued. The date the revision was inserted shall be recorded and initialled below. The usefulness of this manual is dependent upon its being maintained current.

	DATE	INITIAL		DATE	INITIAL
REVISION 1	_____	_____	REVISION 6	_____	_____
REVISION 2	_____	_____	REVISION 7	_____	_____
REVISION 3	_____	_____	REVISION 8	_____	_____
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piping ruptures up to and including the diameter of the largest pipe connected to the reactor vessel.

A rupture in the Reactor Coolant System results in the discharge to the containment of reactor coolant and associated heat. The result of this discharge is a decrease in coolant pressure. The result of this discharge is a decrease in coolant pressure in the Reactor Coolant System and an increase in containment temperature and pressure. Engineered safeguards then operate, if required, to protect the core and return the containment to subatmospheric pressure.

An evaluation was performed to determine the effects on Emergency Core Cooling System performance of the replacement steam generator parameters. The evaluation basis was a comparison with the current large break analysis for Surry which incorporates 20 percent steam generator tube plugging with an F_q of 2.0.

Comparing the parameters of the replacement steam generator with the original steam generators (Tables 4.1-1 and 4.1-2), the following effects are noted:

1. The decrease in the number of tubes while keeping the heat transfer area constant causes an increase in equivalent length and a higher mass flux through the tubes. This results in a 0.9 psi increase in the steady pressure drop across the steam generator tubes.

   Offsetting this, however, is a redesign of the weld between the tubes and the tubesheet which results in a 1 psi decrease in the pressure drop across the steam generators. The net effect is a decrease of 0.1 psi across the steam generator. Due to the slightly lower resistance, a small decrease in peak clad temperature will result.

2. The reduction in steam generator flow area will affect the reflood portion of the transient of an increased resistance to steam venting from the core, thus lowering the reflooding water inlet velocity. This change in flow area can be expressed as being equivalent to 1.5 percent steam generator tube plugging. Based on a conservative estimate of a 10 degree F increase in peak clad temperature for each percent tubes plugged, the calculated peak clad temperature will increase by 115 degrees F over an analysis performed with no tube plugging.

3. The increase in secondary side mass is negligible with respect to LOCA.

It is concluded from this evaluation that the new steam generator parameters have an effect on the LOCA analysis equivalent to approximately 1.5 percent tube plugging. Since the latest large break Surry FSAR analysis was performed at 20 percent tube plugging with an F_q of 2.0, this current analysis is conservative for the unit with replacement steam generators.

Although the results of the review will not be repeated herein, sections of the review which may be especially applicable to the construction period are identified and described below:

Section A.9 of the Response to Appendix A of BTP 9.5-1 identified those systems and structures which are shared by both units. Each is reviewed for the potential effects on the safet shutdown of either reactor in the event of fire. These analyses remain equally as valid when one unit is out of service for maintenance or construction as when both units are operating.

Section F.1.b of the Responses to Appendix A delineates fire protection guidelines for the containment during refueling and maintenance. In accordance with these guidelines, additional fire protection will be provided in areas of the containment where maintenance introduces a fire hazard. Also, in accordance with these guidelines, the quantity and type of combustibles brought into the containment for maintenance purposes will be controlled by procedure.

Section G.1 of the Responses to Appendix A delineates special protection guidelines for welding and cutting. In accordance with these guidelines, such activity will be governed by procedures which conform to NPPA Standards No. 51 and No. 51.3.

4.4.3 Construction Hazards Analysis

Installation activities related to steam generator repair do not differ significantly in type from maintenance activities accomplished during previous outages. Existing administrative procedures will be augmented by additional procedures as necessary to assure that the repair work is carried out safely and that the repair effort does not interfere with the operating unit. Existing station procedures, as supplemented by procedures applicable to the repair program, will be followed. These procedures are fully documented and discussed in the Nuclear Power Station Quality Assurance Manual, the Security Program Manual, the Health Physics Manual, etc. Where appropriate these manuals may be revised in accordance with established procedures. Appropriate precautions will be exercised to assure that radiation exposure will be maintained as low as reasonably achievable, including consideration of the guidelines contained in Regulatory Guide 8.8.

4.4.4 Conclusions

Based on the analyses performed to date, it is not anticipated that the steam generator repair program will have any significant effect on the operating unit and that the repair activities can be completed in a safe manner. Ongoing evaluations which are being conducted while completing detailed engineering are not expected to alter this basic conclusion.

5.0 ENVIRONMENTAL CONSIDERATIONS

5.1 Summary

This section is a presentation of information relating to the environmental impact of the planned steam generator replacement. It addresses the reasons and justification for this action as well as the estimated environmental impact, and the disposal of the removed steam generator lower assemblies.

A cost benefit analysis has been performed to determine the economic incentive for replacement of steam generators. The cost of steam generator replacement was compared to the additional operating expenditures which would be necessary to operate the Surry units with the existing steam generators until the end of station life. The additional operating costs are due to predicted deratings (a highly optimistic scenario was used) and a semiannual three to four week shutdown for each unit for steam generator tube inspection and plugging. The cost of continued operation exceeds the cost of replacement by $125,000,000 in 1977 dollars. This does not include unit shutdowns due to steam generator tube leaks, which are difficult to predict, thus affecting the reliability and availability of the Surry Units. As an example, in 1976 Surry Unit 1 was off-line for 36 days and Unit 2 for 139 days as a result of steam generator related problems and maintenance. This rack of reliability and availability substantially adds to the incentive to replace the steam generators at Surry Power Station.

The total man-rem exposure for the steam generator replacement will be a little less than 4400 man-rem for both units or about 2170 man-rem/unit. In 1975 steam generator maintenance accounted for 638 man-rem and in 1976 it accounted for 1287 man-rem. Based on these numbers, it can be predicted that in the next 4 to 8 years exposure resulting from the maintenance necessary to continue the operation of the present steam generators would exceed the anticipated exposure that would result from replacing the steam generators. The replacement of steam generators will also likely result in a significant reduction of the total exposure that might otherwise occur over the remaining station life.

The environmental impacts of the replacement activities are expected to be negligible.

It is planned to store the removed steam generator lower shells on site in an engineered storage facility until the end of station life. Residual radioactivity due to contamination will be reduced to about 2 percent (between 2 and 20 curies/steam generator) of the activity when first removed. At this time the ultimate disposal will be greatly simplified due to the much lower radiation levels.

As a result of this evaluation it is concluded that:

1. The proposed action is justified on economic as well as man-rem consideration.

2. The proposed action will not affect the health and safety of the general public.

3. The proposed action will not significantly affect the quality of the environment.

The performance of the above tasks will result in doses to individuals possessing craft skills. Table 5.3-1 presents a breakdown of the estimated man-rem dose from direct radiation exposure for the removal of the old steam generators and the installation of the new steam generators. The total exposure predicted for this job is about 2170 man-rem/unit or 4340 man-rem total.

Table 5.3-2 shows a history of in-station exposure for Surry Unit Nos. 1 and 2 for all operations and for steam generator maintenance. In 1975 the total exposure for Surry Power Station was 1649 man-rem total and 638 man-rem for steam generator maintenance. In 1976 the total exposure was 3164 man-rem total and 1287 for steam generator maintenance. In 1975 and 1976, steam generator maintenance accounted for about 40 percent of the station exposure annually. A comparison of the total estimated exposure for the steam generator replacement with the exposure for steam generator maintenance in 1975 and 1976 shows that the exposure for replacement of steam generators will be recovered in between 4 and 8 years. In the remaining years of station life there is a potential savings of between 16,500 and 28,000 man-rem as a result of minimizing the amount of steam generator maintenance which has been experienced to date.

5.3.2.2 Doses to the Public

Due to the nature of the cutting and welding which will take place during the steam generator replacement there is the possibility of airborne particulates being generated. Steps will be taken to minimize or prevent this occurence (i.e. glove boxes, tents, etc.) However, since the ventilation flow in the containment will be maintained so that there will be an inward flow of air through any openings, with the exhaust through the auxiliary building filter banks, the possibility of releases of radioactive particulates is expected to be very small. It is also expected that there may be contaminated liquids generated during these operations associated with local decontamination, laundry, etc. These liquids will be monitored for radioactivity; any releases will be controlled by treatment prior to discharge. Total off-site radiological dose due to replacement activities for each unit is expected to be less than that which would result if the unit were operating.

Following replacement of the steam generators and resumption of operation, it is expected that there will be an over-all reduction in unit operational radiological impact due to improved steam generator performance.

5.3.2.3 Effluent Releases

5.3.2.3.1 Steam Generator Blowdown

The presently installed steam generator blowdown system has a capability to handle approximately 1 percent of the normal feedwater flow or about 270 gpm per generating unit. Although the steam generator internal blowdown system is designed to handle a larger quantity of blowdown, it is not anticipated that the capacity of the existing blowdown system will be increased.

The presently installed blowdown system consists of coolers which use condensate flow as the cooling medium. The cooled blowdown water is discharged to the James River. The effluent releases from this system, including resultant radiation exposures from this source are presented in the "Appendix I Analyses" dated June 1977 which was submitted to the NRC on June 17, 1977, Serial No. 247. The replacement activities described herein are intended to restore the integrity of the steam generators, thus reducing the primary to secondary leakage which now exists. The net effect of the installation of the new steam generator lower assemblies is to reduce the radiation dose attributable to steam generator blowdown. Therefore the requirements of Appendix I, 10CFR50 will continue to be maintained.

5.3.2.3.2 Full Flow Demineralizers

In order to assure the continued integrity of the steam generators following the replacement activities, full flow condensate demineralizers will be installed. The system to be installed is similar to that described in the North Anna Power Station, Unit Nos. 3 and 4 PSAR, Docket Nos. 50-404 and 50-405. The final design has not been established; therefore, the exact quantities of effluent releases associated with the system has not been established. However, it is not expected that the installation and operation of the demineralization system will have any significant impact on the effluent releases for the station.

5.3.3 Non-Radiological Impacts

5.3.3.1 On-Site Impacts

Most of the work associated with the replacement of Units Nos. 1 and 2 steam generators, excluding disposal, will occur within the containment building of each unit. Most of the preparatory work prior to removal of the steam generators will be such that the environment around the units will be similar to that during an outage for refueling. Following shutdown the only significant activity that will occur on site which will be unusual will be the removal of the steam generators through the equipment hatch and the transportation of the new steam generators from the barge offloading facilities, located 1.5 miles from the containment structure. There will essentially be no impact resulting from this operation.

The noise generated by this operation will be of low volume. Since new construction will be limited to the onsite steam generator storage facility, erosion and groundwater level modifications are not expected to occur. Additional air pollutants will occur as a result of the operation of mobile cranes and air compressors, but they will be minimal in nature. Very little dust will be raised by the transport of the steam generators from the barge offloading facility because of the low speed of the transporter vehicle and the few times it will be used.

The estimated 125 workers per shift will use temporary sanitary facilities. No release to the James River is anticipated.

The construction of the building to house the old steam generators will require some excavation work for leveling. The extent of disturbance will be small and the impact is not expected to be great.

5.3.3.2 Off-Site Impacts

The primary off-site impact is expected to be the local increase in automobile traffic of the workers involved in the project. However, this is expected to be substantially less than the traffic during the construction of Surry Unit Nos. 1 and 2.

No other off-site impacts are anticipated.

5.4 Environmental Monitoring Programs

5.4.1 Radiological Monitoring

5.4.1.1 Airborne Effluents

Prior to removing a steam generator from the containment, all openings in the old steam generator will be sealed to prevent spread of internal contamination. The building ventilation circulation is such as to preclude the release of particulates to the ambient air via the open equipment hatch since the air pressure will be slightly negative resulting in an inward flow and the containment ventilation exhaust is filtered prior to release to the atmosphere.

The steam generator replacement operation will not generate any additional radioactive gases or result in any emissions of radioactive gases in excess of those normally associated with steam generator inspection and tube plugging and reactor refueling operation. Therefore, no additional monitoring for gaseous effluents is planned.

Particulates may be generated or released from components as a result of mechanical operations in the steam generator removal and replacement process and as a result of decontamination. Some of these operations will be conducted in tents or similarly controlled and vented areas for personnel protection in order to reduce the potential for spreading such particulates. Existing radiological control procedures will be maintained during the replacement work of the steam generators.

Ventilation monitoring will be conducted using normal procedures and frequencies unless a change in conditions indicates increased monitoring is necessary because of a release of particulates to the ventilation system in excess of expected levels.

Particulate sampling in work areas will be based upon existing procedures in effect at Surry.

5.4.1.2 Liquid Effluents

Radioactive liquids at Surry are monitored prior to and during discharge to the environment. Existing procedures will be employed to monitor effluents. Some additional monitoring may be required because of the additional volumes which may be required to be processed as a result of cleaning operations. However, these are within existing procedures. No change in the existing environmental radiological monitoring program is anticipated as a result of the steam generator replacement activities.

5.4.2 Non-Radiological Monitoring

The only non-radiological emissions anticipated will be minor exhaust emissions from hauling and lifting equipment, trucks and worker auto

traffic. Some dust may also be dispersed as a result of auto and truck traffic and equipment lay down and movement. The effects are anticipated to be minor and of no significant environmental impact either on or off site.

5.5 Consideration of Alternatives

5.5.1 Alternatives to Replacement of the Steam Generators

The alternatives to the replacement of steam generator are:

1. Continue to operate Unit Nos. 1 and 2 with the existing steam generators.

2. Retube the existing steam generators.

3. Shutdown and decommission Unit Nos. 1 and 2 and build replacement units.

These alternatives are discussed below.

5.5.1.1 Continued Operation with the Installed Steam Generators

Degradation of the steam generators at Surry has been occurring since early 1975. As a result of preventive and corrective plugging about 19-20 percent of the tubes are currently plugged. It appears likely that continued plugging will be required. Continued operation involves the risk that at some undetermined time in the future the replacement may have to be undertaken in any case. A planned and orderly replacement now is preferable to a future unpropitious shutdown and replacement, especially if that were to happen during a period such as the 1973 oil embargo when replacement power might be difficult to obtain.

Continued operation may also result in deratings due to additional tube plugging. It will also require semiannual or more frequent and unscheduled shutdowns for inspection and tube plugging. Over the remaining 30 years of station life this will result in large economic expenditures for replacement power. It also results in a loss of availability and reliability which need to be maintained to meet the needs of the public.

5.5.1.2 Retubing Existing Steam Generators

The retubing of the existing steam generators would consist of removing only the tube bundles and replacing them with new tubes. It has been estimated that this operation be at least as costly as the total replacement of steam generators. It will also result in at least as much personnel exposure as the total replacement of steam generators lower assemblies.

The physical arrangement of the containment structure affects the alternate chosen. Retubing may be a viable alternative in a containment where the equipment hatch location makes the removal and reinstallation of a steam generator difficult or impossible without large scale removal of structural components. In the case of Surry, the equipment hatch is located on the operating level of the containment which makes the removal and reinstallation of steam generators a fairly straight forward operation. The acceptability of the refurbished steam generator is assured by replacement rather than retubing since the work is performed in a manufacturing facility under controlled conditions rather than in the field. The use of new material used in the replacement lower assemblies provides positive assurance that the refurbished steam generators are "like new".

For Surry Power Station, replacement of steam generators is a more logical alternative than the retubing of steam generators alternative when the above factors are considered.

5.5.1.3 Shutdown and Decommission Unit Nos. 1 and 2 and Construct Replacement Units

The time to construct new replacement units would be approximately 12½ years for a nuclear unit and 8 years for a fossil unit. The capital costs for these units would be about $2.97 billion and $1.35 billion respectively. During the 8-12 year construction period, the VEPCO system would have to provide additonal generation to replace the Surry Units. The current Vepco reserve capacity is below that which Vepco normally prefers to maintain and this deficiency in reserve capacity is expected to be accentuated during 1981 and 1982.

The construction of two new units would involve a greater impact with regards to noise, air and water quality, aquatic and terrestrial biota that would the replacement of the existing steam generators. The construction of two new units would involve the normal disturbances associated with such activities. A large amount of earth-moving and excavation work would be required. New intake and discharge structures would be required. Noise levels would increase resulting from the operation of heavy equipment. Additional land would be disturbed in the construction of these facilities.

If the units were replaced by two coal-burning units, gaseous releases would be approximately 1,482 lbs of particulate per hour. The SO_2 emissions from these two units could range from 2,500 - 8,900 lbs per hour. The two coal-fired units would produce approximately 28 million tons of fly ash and SO_2 removal sludge. The cost

for disposing of this sludge would be $5.6 million for land and improvements and $36.3 million for transportation of the waste.

If the new replacement units were nuclear, radioactive releases from replacement nuclear units would be approximately the same as those associated with Unit Nos. 1 and 2 with the steam generators replaced. Solid wastes, both in volume and activity, would also be of the same magnitude as the existing units with the steam generators replaced.

The commitment of resources such as man-power, material, and energy would be significantly greater for this option than for replacement of the steam generators.

5.5.2 Alternatives Within the Project

Assuming that steam generator replacement will be undertaken, there are a few alternatives which were considered as part of the project. They are:

1. Decontamination Alternatives.

2. Steam Generator disposition alternatives.

A discussion of each follows.

5.5.2.1 Decontamination Alternatives

In order to reduce occupational doses, several decontamination alternatives have been studied. These alternatives include:

1. Chemical Decontamination of the entire NSSS.

2. Chemical Decontamination of the individual loops.

3. Mechanical decontamination of the steam generator only, while part of the NSSS.

4. Mechanical decontamination of the steam generator after being cut from the NSSS, but not removed from containment.

Based upon these evaluations it has been concluded that none of the decontamination alternatives can be justified by a cost-benefit analysis. Table 5.5-1 shows the basis data from which this conclusion is drawn.

5.5.2.2 Steam Generator Disposition Alternatives

Three basic options were considered for the disposition of the steam generator lower shells after they are removed.

Option 1 is to store the steam generators onsite in an engineered storage facility which is the chosen option and is described in Section 5.3.1.

Option 2 is intact barge shipment. The steam generators would be decontaminated inside and out, loaded on a barge, and shipped to a licensed burial ground. The offloading facilities at the existing burial grounds are inadequate for the steam generator loads thereby eliminating this option. Also due to the number of tubes plugged which could not be decontaminated it may be difficult to achieve the decontamination factor necessary to meet Department of Transportation regulations for radioactive materials. For these reasons this option is not presently a viable alternative.

Option 3 is on site sectioning for offsite disposal. The steam generators would be removed from the containment to a specially constructed facility where they would be decontaminated and then cut up with plasma arc torches. As in option 2 the required decontamination factor may be difficult to achieve due to the number of tubes plugged.

A summary of the costs and man-rem exposure associated with each of these options is contained in table 5.5-2.

5.6 Irretrievable Commitments of Resources

5.6.1 Manpower

The total manpower required for the project including documentation, licensing activities, etc., is estimated to be 350,000 man hours per unit. Of this about 310,000 man hours are estimated to be required for the direct labor involved in the removal and replacement of three steam generators per unit.

5.6.2 Economic Costs

The cost of purchasing and installing the replacement steam generator lower assemblies and associated activities is about $66,000,000. The cost of removal and disposal of the lower assemblies is not expected to exceed $10,000,000. The cost of replacement power during this action will be about $66,000,000 resulting in a total project cost of $142,000,000.

5.6.3 Material Costs

The major material cost is for the of steel used in the construction of the steam generators, piping, connections, and insulation. It is estimated that of the 1400 tons of carbon steel required for the project about 1,320 tons will be used in the fabrication of the six steam generators.

TABLE 5.3-1
ESTIMATED IN PLANT RADIATION DOSE FOR
STEAM GENERATOR REPLACEMENT

		Dose (man-rem/generator)	Dose (Man-rem/Unit)
1.	Preparation of the containment for removal activities		37
2.	Steam Generator Removal		
	a. Removal of Insulation	13	
	b. Cutting of Steam Generator	3	
	c. Cutting of Reactor Coolant Piping	105	
	d. Cutting of Main Steam, Feedwater and Misc. Piping	14	
	e. Removal of Steam Generator Lower Shell	17	
	f. Removal of Feedring and Moisture Separation Equipment	15	
	g. Misc.	15	
		182	546
3.	Steam Generator Installation		
	a. Installation of Steam Generator Lower Shell	4	
	b. Installation of Reactor Coolant Piping	59	
	c. Steam Generator Welding	2	
	d. Installation of Main Steam Feedwater and Misc. Piping	13	
	e. Installation of Insulation	10	
	f. Misc.	15	
		103	309

TABLE 5.3-1 CONTINUED

		Dose (man-rem/generator)	Dose (Man-rem/Unit)
4.	Preparation and Cleanup of Containment For Startup		26
5.	Support Craftsmen (semi-skilled)		1038
6.	Health Physics, Q.A./Q.C. and Administrative Personnel		177
7.	Transport of Steam Generators to On-Site Storage Facility		35
		TOTAL	2168

Total For Both Units 4336 Man-rem

TABLE 5.5-1

COMPARISION OF VARIOUS DECONTAMINATION ALTERNATIVES

(Alternatives)

	Chemical Decontamination of NSSS	Chemical Decontamination of Individual Loops	Mechanical Decontamination of SG Before Cutting from NSSS	Mechanical Decontamination of SG Following Cutting from NSSS
1. Man-rem Impact				
(a) reduction in personnel exposure	888	824	107	T
(b) man-rem exposure resulting from decontamination	500	555	105-210	T
(d) net reduction in man-rem exposure	388	269	549-4442-(103)*	T
2. Wastes Generated	232,000 gal.	116,000 gal.	29,5000 lbs.	29,550 lbs.
3. Impact on Schedule (months)	1.5	1.5	0.06-0.11	0.06-0.11
4. Cost of Decontamination ($\$10^6$)	11.0	11.0	0.59-1.05	0.59-1.05

T=Considerably less than alternative 3

*=An increase over the base case of up to 103 man rem.