STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

*SEE INSTRUCTIONS ON REVERSE SIDE

▲ 5010.64 (FRONT)

CLIENT & PROJECT	PAGE 1 OF 8
PRIVATE FUEL STORAGE FACILITY (PFSF)	
CALCULATION TITLE (Indicative of the Objective): PFSF TRANSPORTATION IMPACTS	QA CATEGORY (✓) ☐ I - NUCLEAR SAFETY RELATED ☐ II ☒ III ☐ ____ OTHER

CALCULATION IDENTIFICATION NUMBER				OPTIONAL WORK PACKAGE NO.
J.O. OR W.O. NO.	DIVISION & GROUP	CURRENT CALC. NO.	OPTIONAL TASK CODE	
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* APPROVALS - SIGNATURE & DATE			REV. NO. OR NEW CALC NO.	SUPERSEDES * CALC. NO. OR REV. NO.	CONFIRMATION * REQUIRED (✓)	
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/DATE(S)			YES	NO
PWMichaud 5-9-97	JR Johns/5/12/97	N/A	0	—		✓

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CALCULATION SHEET

STONE AND WEBSTER ENGINEERING CORPORATION

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SUBJECT/TITLE	QA CATAGORY/CODE CLASS
PFSF TRANSPORTATION IMPACTS	III

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(Revisions, Additions, Deletions, etc.)

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CALCULATION SUMMARY

STONE & WEBSTER ENGINEERING CORPORATION

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CLIENT/PROJECT	QA CATEGORY/CODE CLASS
PRIVATE FUEL STORAGE FACILITY (PFSF)	III

SUBJECT/TITLE

PFSF TRANSPORTATION IMPACTS

OBJECTIVE OF CALCULATION

TO EXTRAPOLATE DATA ON IMPACTS TO WORKERS AND THE GENERAL PUBLIC IN ORDER TO DETERMINE WHETHER THE IMPACTS OF TRANSPORTATION ACTIVITIES ASSOCIATED WITH THE PFSF ARE ACCEPTABLE.

CALCULATION METHOD/ASSUMPTIONS

1. USE DATA FROM TABLE S-4 IN 10 CFR 51.52.
2. CALCULATE AVERAGE EXPOSURES AND IMPACTS, ASSUMING THE SAME INDIVIDUALS WORK ON OR ARE PRESENT FOR ALL TRANSPORTATION ACTIVITIES, THAT EACH OF THE REACTORS EXPECTED TO UTILIZE THE PFSF DOES SO IN A GIVEN YEAR, AND THAT EACH REACTOR HAS THE MAXIMUM THERMAL POWER AND CAPACITY FACTOR ASSUMED IN TABLE S-4.

SOURCES OF DATA/EQUATIONS

1. 10 CFR 51.52 AND THE ASSOCIATED SUMMARY TABLE S-4.
2. ENVIRONMENTAL SURVEY OF TRANSPORTATION OF RADIOACTIVE MATERIALS TO AND FROM NUCLEAR POWER PLANTS, WASH-1238, DECEMBER 1972, USAEC
3. SUPPLEMENT 1 TO WASH-1238, NUREG-75/038, APRIL 1975, USNRC
4. 10 CFR 20.1201
5. 10 CFR 20.1301
6. PFSF SAR
7. PFSF RFP-MAT/UC-95-102, 9-9-95

CONCLUSIONS

THE IMPACTS TO BOTH WORKERS AND THE GENERAL PUBLIC FROM PFSF TRANSPORTATION ACTIVITIES ARE ACCEPTABLE. THE RADIOLOGICAL IMPACTS ARE WITHIN THE ALLOWABLE LIMITS OF 10 CFR 20.1201 AND 20.1301, AND THE NON-RADIOLOGICAL IMPACTS ARE ACCEPTABLE CONSIDERING THE CONSERVATISM INVOLVED AND THE OFFSETTING BENEFITS.

REVIEWER(S) COMMENTS		
	PREPARER: RWMichaud	DATE: 5-9-97
	REVIEWER/CHECKER: JR John	DATE: 5-12-97
	INDEPENDENT REVIEWER: N/A	DATE:

THE ENVIRONMENTAL IMPACTS OF TRANSPORTATION ACTIVITIES ASSOCIATED WITH THE PFSF ARE ADDRESSED IN 10 CFR 51.52, SUMMARY TABLE S-4.

THE DATA IN TABLE S-4 ARE EXPRESSED IN TERMS OF A REFERENCE REACTOR YEAR, WHICH ASSUMES OPERATION OF A 3800 MW(th) REACTOR AT 80% POWER FOR A FULL YEAR.

THE TABLE S-4 DATA MUST BE EXTRAPOLATED USING SPECIFIC PARAMETERS FOR THE PFSF AND CONSERVATIVE ASSUMPTIONS TO OBTAIN REPRESENTATIVE VALUES FOR PFSF ACTIVITIES TO COMPARE WITH ALLOWABLE LIMITS AND VERIFY THE IMPACTS ARE SUFFICIENTLY LOW.

THIS EFFORT WILL DETERMINE THE ADEQUACY OF THE TABLE S-4 DATA FOR PFSF TRANSPORTATION ACTIVITIES.

1. NUMBER OF SHIPMENTS / TRAFFIC DENSITY

ALL SHIPMENTS OF SPENT FUEL TO AND FROM THE PFSF WILL BE BY RAIL, WITH THE USE OF HEAVY HAUL TRAILERS BETWEEN THE PFSF AND THE INTERMODAL TRANSFER POINT AND AS NECESSARY BETWEEN THE ORIGINATING REACTOR AND THE NEAREST RAILHEAD.

THE DATA SUPPORTING TABLE S-4 IN REFERENCES 2 AND 3 ASSUME 10 RAIL SHIPMENTS OF SPENT FUEL PER REACTOR-YEAR.

THERE ARE 20 REACTORS WHICH INITIALLY PLAN TO UTILIZE THE PFSF. ASSUME EACH OF THESE REACTORS IS 3800 MW(th) AND HAS OPERATED AT 80% CAPACITY EACH YEAR (THIS IS VERY CONSERVATIVE SINCE A MAJORITY OF THESE REACTORS HAVE A MAXIMUM THERMAL POWER SIGNIFICANTLY LESS THAN 3800 MW AND PROBABLY DO NOT AVERAGE AN 80% CAPACITY EACH YEAR).

THE NUMBER OF SHIPMENTS PER YEAR WILL THEREFORE BE:

$$20 \text{ REACTORS} \times 10 \frac{\text{RAIL SHIPMENTS}}{\text{REACTOR-YEAR}} = 200 \frac{\text{RAIL SHIPMENTS}}{\text{YEAR}}$$

1. NUMBER OF SHIPMENTS / TRAFFIC DENSITY (CONT.)

THE TABLE S-4 RAIL TRAFFIC DENSITY OF "LESS THAN 3 SHIPMENTS PER MONTH" WOULD CONCEIVABLY ALLOW 35 RAIL SHIPMENTS PER REACTOR-YEAR. THE MAXIMUM NUMBER OF SHIPMENTS TO THE PFSF WOULD THEREFORE BE:

$$35 \frac{\text{RAIL SHIPMENTS}}{\text{REACTOR-YEAR}} \times 20 \text{ REACTORS} = 700 \frac{\text{RAIL SHIPMENTS}}{\text{YEAR}}$$

AT 200 SHIPMENTS PER YEAR, THE NUMBER OF PFSF SHIPMENTS WOULD BE $\frac{200}{700} = 0.286 = 28.6\%$, OR LESS THAN 30% OF THE TRAFFIC DENSITY ASSUMED UNDER TABLE S-4.

2. OCCUPATIONAL EXPOSURE TO TRANSPORTATION WORKERS

TABLE S-4 STATES THAT THE CUMULATIVE DOSE TO TRANSPORTATION WORKERS IS 4 MAN-REM PER REACTOR-YEAR, RECEIVED BY 200 WORKERS. THE MAXIMUM DOSE TO AN INDIVIDUAL IS 0.3 REM PER REACTOR-YEAR, BUT IT IS NOT REASONABLE TO ASSUME THE SAME INDIVIDUAL WILL RECEIVE THE MAXIMUM EXPOSURE FROM EACH SHIPMENT.

A MORE REPRESENTATIVE ESTIMATE OF OCCUPATIONAL EXPOSURE IS TO ASSUME AN INDIVIDUAL RECEIVES AN AVERAGE EXPOSURE FROM EACH SHIPMENT. IN PRACTICAL TERMS, AN INDIVIDUAL IS NOT LIKELY TO WORK ON EACH SHIPMENT AND RECEIVE THE SAME EXPOSURE; SOME WILL BE HIGHER THAN AVERAGE, SOME LOWER, AND SOME ZERO.

CALCULATING THE AVERAGE DOSE TO AN INDIVIDUAL ASSUMED TO WORK ON EACH SHIPMENT PROVIDES A CONSERVATIVE AND SOMEWHAT REPRESENTATIVE DOSE FOR COMPARISON WITH ALLOWABLE LIMITS TO EVALUATE THE IMPACTS FROM SUCH ACTIVITIES.

THE AVERAGE DOSE TO TRANSPORTATION WORKERS UNDER TABLE S-4 IS:

$$4 \frac{\text{MAN-REM}}{\text{REACTOR-YEAR}} \div 200 \text{ PERSONS} = 0.02 \frac{\text{REM}}{\text{REACTOR-YEAR}}$$

THE AVERAGE DOSE TO PFSF TRANSPORTATION WORKERS WOULD THEREFORE BE:

$$0.02 \frac{\text{REM}}{\text{REACTOR-YEAR}} \times 20 \text{ REACTORS} = 0.4 \frac{\text{REM}}{\text{YEAR}}$$

2. OCCUPATIONAL EXPOSURE TO TRANSPORTATION WORKERS (CONT.)

COMPARE THE AVERAGE DOSE TO PFSF TRANSPORTATION WORKERS TO THE ALLOWABLE OCCUPATIONAL EXPOSURE OF 5 $\frac{REM}{YEAR}$ IN 10 CFR 20.1201:

$$0.4 \frac{REM}{YEAR} \div 5 \frac{REM}{YEAR} = 0.08 = 8\% \text{ OF ALLOWABLE DOSE}$$

THE PROJECTED OCCUPATIONAL EXPOSURE TO THE AVERAGE TRANSPORTATION WORKER IS ACCEPTABLE BASED NOT ONLY ON THE RESULT BEING A SMALL FRACTION OF THE ALLOWABLE LIMITS, BUT ALSO CONSIDERING THE CONSERVATIVE ASSUMPTIONS USED IN CALCULATING THIS PROJECTED EXPOSURE.

3. NON-OCCUPATIONAL EXPOSURES RELATED TO TRANSPORTATION

TABLE S-4 STATES THAT THE CUMULATIVE DOSE TO THE GENERAL PUBLIC IS 3 MAN-REM PER REACTOR-YEAR, WHICH IS RECEIVED BY 1,100 ONLOOKERS AND 600,000 INDIVIDUALS ALONG THE TRANSPORTATION ROUTE.

THE DATA SUPPORTING TABLE S-4 IN REFERENCES 2 AND 3 DO NOT PROVIDE A BREAKDOWN OF THE 3 MAN-REM BETWEEN THE 1,100 ONLOOKERS AND THE 600,000 INDIVIDUALS ALONG THE TRANSPORTATION ROUTE. HOWEVER, TABLE S-4 DOES LIST THE MAXIMUM EXPOSURE TO AN INDIVIDUAL MEMBER OF THE GENERAL PUBLIC AS 1.3 MILLIREM (0.0013 REM) PER REACTOR-YEAR.

IF THE SAME INDIVIDUAL MEMBER OF THE GENERAL PUBLIC RECEIVED THE MAXIMUM DOSE FROM ALL PFSF SHIPMENTS, THAT PERSON WOULD RECEIVE:

$$1.3 \frac{MILLIREM}{REACTOR\text{-}YEAR} \times 20 \text{ REACTORS} = 0.026 \frac{REM}{YEAR}$$

COMPARE THIS MAXIMUM DOSE TO A MEMBER OF THE GENERAL PUBLIC FROM PFSF TRANSPORTATION ACTIVITIES TO THE ALLOWABLE EXPOSURE OF 0.1 $\frac{REM}{YEAR}$ IN UNRESTRICTED AREAS AS REQUIRED BY 10 CFR 20.1301:

$$\frac{0.026}{0.1} = 0.26 = 26\% \text{ OF ALLOWABLE EXPOSURE}$$

3. NON-OCCUPATIONAL EXPOSURES RELATED TO TRANSPORTATION (CONT.)

THEREFORE, THE MAXIMUM DOSE TO A MEMBER OF THE GENERAL PUBLIC FROM PFSF TRANSPORTATION ACTIVITIES IS ONLY 26% OF THE ALLOWABLE DOSE IN UNRESTRICTED AREAS. THIS ASSUMES THE SAME INDIVIDUAL IS ESSENTIALLY IN THE SAME LOCATION AND RECEIVES THE MAXIMUM EXPOSURE FROM EACH SHIPMENT, WHICH IS EXTREMELY CONSERVATIVE AND IN PRACTICAL TERMS, NEARLY IMPOSSIBLE.

THE PROJECTED MAXIMUM EXPOSURE TO AN INDIVIDUAL MEMBER OF THE GENERAL PUBLIC FROM PFSF ACTIVITIES IS ACCEPTABLE BASED NOT ONLY ON THE RESULT BEING A FRACTION OF THE ALLOWABLE LIMITS, BUT ALSO CONSIDERING THE CONSERVATIVE ASSUMPTIONS USED IN CALCULATING THIS PROJECTED EXPOSURE.

4. IMPACTS FROM TRANSPORTATION ACCIDENTS

TABLE S-4 STATES THAT THE RADIOLOGICAL EFFECTS FROM TRANSPORTATION ACCIDENTS ARE SMALL AND INCAPABLE OF BEING NUMERICALLY QUANTIFIED.

TABLE S-4 STATES THAT THE NON-RADIOLOGICAL IMPACTS FROM ACCIDENTS IN TRANSPORT ARE:

1 FATAL INJURY IN 100 REACTOR-YEARS
1 NON-FATAL INJURY IN 10 REACTOR-YEARS
$475 PROPERTY DAMAGE PER REACTOR-YEAR

THE DATA SUPPORTING TABLE S-4 IN REFERENCES 2 AND 3 INDICATE THE STATED IMPACTS ARE BASED ON ALL TRANSPORTATION OCCURRING BY TRUCK. IF SPENT FUEL IS TRANSPORTED BY RAIL, REFERENCE 3 STATES THE NON-RADIOLOGICAL IMPACTS FROM TRANSPORTATION ACCIDENTS ARE:

3 FATALITIES IN 1,000 REACTOR-YEARS
3 NON-FATAL INJURIES IN 100 REACTOR-YEARS
$120 PROPERTY DAMAGE PER REACTOR YEAR

4. IMPACTS FROM TRANSPORTATION ACCIDENTS (CONT.)

THE NON-RADIOLOGICAL IMPACTS FROM TRANSPORTATION ACCIDENTS ASSOCIATED WITH THE PFSF WOULD BE:

$$\frac{3 \text{ FATALITIES}}{1{,}000 \text{ REACTOR-YEARS}} \times 20 \text{ REACTORS} = 0.06 \frac{\text{FATALITIES}}{\text{YEAR}}, \text{ OR}$$

APPROXIMATELY 1 FATALITY IN 16.7 YEARS

$$\frac{3 \text{ NON-FATAL INJURIES}}{100 \text{ REACTOR-YEARS}} \times 20 \text{ REACTORS} = 0.6 \frac{\text{NON-FATAL INJURIES}}{\text{YEAR}}, \text{ OR}$$

APPROXIMATELY 1 NON-FATAL INJURY IN 1.7 YEARS

$$\$120 \frac{\text{PROPERTY DAMAGE}}{\text{REACTOR-YEAR}} \times 20 \text{ REACTORS} = \$2{,}400 \frac{\text{PROPERTY DAMAGE}}{\text{YEAR}}$$

FOR 40 YEARS OF PFSF OPERATION, THERE WOULD BE:

$$0.06 \frac{\text{FATALITIES}}{\text{YEAR}} \times 40 \text{ YEARS} = 2.4, \text{ OR APPROXIMATELY 3 FATALITIES}$$

$$0.6 \frac{\text{NON-FATAL INJURIES}}{\text{YEAR}} \times 40 \text{ YEARS} = 24 \text{ NON-FATAL INJURIES}$$

$$\$2{,}400 \frac{\text{PROPERTY DAMAGE}}{\text{YEAR}} \times 40 \text{ YEARS} = \$96{,}000 \text{ PROPERTY DAMAGE}$$

THESE IMPACTS ARE ACCEPTABLE BECAUSE THEY ARE RELATIVELY SMALL, BECAUSE OF THE OFFSETING BENEFITS THE PFSF WILL PROVIDE, AND BECAUSE OF THE CONSERVATISM INCLUDED IN THEIR DERIVATION.