NRC FORM 195 (2-76)

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NUMBER 50-220

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TO: Mr Lear

FROM: Niagara Mohawk Pwr Corp
Syracuse, NY
R R Schenider

DATE OF DOCUMENT 10-22-76

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INPUT FORM

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DESCRIPTION

Ltr re their 10-1-76 ltr....furnishing info concerning potential misile damage from the solid catwakk......

PLANT NAME: Nine Mile Pt #1

ENCLOSURE

FOR ACTION/INFORMATION

SAFETY — ENVIRO 10-1-76 ehf

	SAFETY			ENVIRO
	ASSIGNED AD:			ASSIGNED AD:
/	BRANCH CHIEF:	Lear		BRANCH CHIEF:
/	PROJECT MANAGER:	Nowicki		PROJECT MANAGER:
/	LIC. ASST.:	Parrish		LIC. ASST.:

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/	ACRS 16 CYS HOLDING/SENT		~~[illegible]~~		AS CAT "B"

CONTROL NUMBER: 10818

NRC FORM 195 (2-76)

NIAGARA MOHAWK POWER CORPORATION

NIAGARA MOHAWK

300 ERIE BOULEVARD, WEST
SYRACUSE, N. Y. 13202

October 22, 1976

Director of Nuclear Reactor Regulation
Attn: Mr. George Lear, Chief
Operating Reactors Branch #3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Dear Mr. Lear:

In our October 1, 1976 letter, we indicated that the probability of failure of a line of sufficient size to cause potential missile damage from the solid catwalk at Nine Mile Point Unit 1 was 2×10^{-5}. This analysis has been found to be in error. The results of the attached re-analysis indicates that the probability of failure of a line of sufficient size which could potentially cause some catwalk failure is no greater than 2×10^{-6}. This is for the time interval between now and the scheduled Spring, 1977 refueling outage.

A detailed analysis of catwalk failure and subsequent penetration of containment bellows has not been done. However, it has been estimated that the overall probability of pipe failure with resulting catwalk failure and containment penetration is at least a factor of 10 less than the pipe failure probability stated above. The following conservatisms incorporated into the attached analysis are the basis for this conclusion.

1. Flexibility of flat plate was neglected. This would have the effect of reducing pressure on the catwalk structure.

2. Total catwalk area was assumed to be impacted at one time. Actually, impact starts at the outer edge and continues inward towards the torus shell.

3. No credit was taken for distortion of plate and channels. These will absorb much of the impact energy.

4. No credit was taken for the very short duration of the peak pressure (only 2 or 3 msec.) on catwalk. Amplification for this duration is < 0.2.

10818

5. Penetration of the bellows must occur to violate containment function. Geometric factors may prohibit this due to catwalk hinging at the ring girder.

6. Catwalk plate welds to the support structure are very strong, thus precluding plate tear off.

Therefore, Nine Mile Point Unit 1 can be operated without any undue hazard to the public health and safety until the scheduled Spring, 1977 refueling.

Very truly yours,

R. R. Schneider
Vice President-Electric Production

PROBABILISTIC ANALYSIS

FOR POTENTIAL OF CATWALK MISSILES

AT NINE MILE POINT UNIT 1

The following method was used to calculate the probability that a line failure of sufficient size to cause a potential for catwalk failure would occur.

1. First, the ultimate uniform pressure on the bottom of the catwalk was determined, i.e., the pressure which would fail the connections was determined. Primary bending of the checkered plate and bending of the support channels were ignored since excessive bending would not cause missiles to be generated. But, the connections were analyzed to determine the pressure at which they would fail. It was found that welds around the perimeter of the plate would fail at 162 psi. The bolts would fail in shear at 20.7 psi, the gusset plate welds would fail at 40.0 psi and the gussets would fail in bearing at 11.1 psi. Therefore, the ultimate uniform pressure on the bottom of the catwalk is 11.1 psi.

2. Tests at General Electric have established some relationships of impact pressure on a flat target with the impact velocity. Although there is limited data, and there is little knowledge of the impulse duration, it was estimated from the data that the ultimate pressure of 11.1 psi would occur for an impact velocity of 8 feet per second.

3. The next step was to find a pipe size which would produce a pool swell velocity of 8 feet per second if the pipe suffered a double-ended break. Figure 3-3 of Addendum 3 of the GE Mark I Report[1] made it possible for us to find the break area. This figure plots the normalized impact velocity at the vent header as a function of the normalized break area to drywell volume ratio. First, the catwalk impact velocity was scaled up to give the corresponding vent header impact velocity, 11.4 feet per second. This was done with the aid of the velocity grid, Figure 4-2, and the corresponding velocity grid values, Table 6.4 of Addendum 3. Then, knowing the vent header impact velocity, and the drywell volume allowed us to obtain a break area, 1.63 square feet, which corresponds to a pipe diameter of 17 inches.

4. From the Rasmussen Report, WASH-1400, a conservative estimate of the probability was made as follows:

    a. In the following analysis, consideration is given to the expectation of catastrophic failure for piping in Nine Mile Point which could result in unacceptable forces on the catwalk.

[1]General Electric Company, NEDC-20989-P, Addendum 3, "Mark I Containment Evaluation Short Term Program Final Report," August, 1976.

b. An estimate of the probability of this event may be found by modifying in the following ways the expected number of pipe failures per plant per year given in WASH-1400.

i) The probability of the event should accommodate the fact that only a fraction of the piping is relevant in a causative way.

ii) The probability of the event should reflect the fact that the event can only happen over a fraction of the year.

iii) The probability of the event should reflect the relative failure probabilities of >18" piping (the relevant piping in Nine Mile Point) compared to piping >6" (the basis used in WASH-1400).

iv) The probability of the event should reflect the fact that for the torus problem, pipes must not only fail, but they must fail catastrophically.

We define the following:

P_{rss} = probability of pipe failure/plant year (actually the expected number/year) in WASH-1400.

P_{NMP1} = probability/year of pipe failure in piping relevant to the torus problem at Nine Mile Point.

P_f = probability/year at Nine Mile Point that failure will occur before structural support modifications are complete.

N^{PB}_{6-18} = number of joints used for calculations in WASH-1400 between 6" and 18" in diameter = 189.

$N^{PB}_{>18}$ = number of joints used for calculations in WASH-1400 > 18" in diameter = 5.

P_{6-18} = probability/pipe year of failure for joints in piping 6-18" in diameter.

$P_{>18}$ = probability/pipe year of failure for joints in piping > 18" in diameter.

In WASH-1400, the mean frequency of BWR pipe failure over the lifetime of the plant is taken to be 10^{-4}/plant year; thus, $P_{rss} = 10^{-4}$/plant year.

In WASH-1400, it was assumed that all pipes fail with the same probability (i.e., that $\frac{P_{6-18}}{P_{>18}} = 1.0$). Estimates of the relative probability of pipe severance indicate, however, that the ratio is approximately 10 to 1[2].

If one allocates the probability of pipe failure directly to failure at joints, then:

$$P_{rss} = [N^{PB}_{6-18} \frac{P_{6-18}}{P_{>18}} + N^{PB}_{>18}] \; P_{>18} = [189(10) + 5] \; P_{>18} =$$

$$1895 \; P_{>18}$$

and

$$P_{>18} = \frac{1 \; P_{rss}}{[N^{PB}_{6-18} (\frac{P_{6-18}}{P_{>18}}) + N^{PB}_{>18}]} = \frac{10^{-4}}{1895} = 5.28(10)^{-8} \text{ per yr}$$

These estimates considered the following:

a. Increased actual stress

P_m, general membrane stress. Incorrect operation: hydraulic transients, overpressure.

P_l or P_b local membrane or bending stresses. Excessive flexibility: lack of support, or excessive load.

P_e, expansion stress. Inadequate flexibility: interference.

Q, local thermal stress. Incorrect operation: flow temperature fluctuation.

[2]actually .0451/.0041 from Table 10-2, GEAP 20615.

b. Decreased critical stress

c. Increased crack frequency (occurrence rate per unit surface area)

d. Increased crack growth rate due to other than increased actual stress

e. Decreased crack detection capability

In Nine Mile Point, there are 90 weld joints which are important as possible origins of a fault which could produce structurally unacceptable torus forces. In every case, piping > 18" is involved.

$$P_{NMP} = 90\, P_{>18} = 90(5.28)(10)^{-8} = 4.7(10^{-6}) \text{ per yr.}$$

If one includes the fact that the event of interest can only occur before a modification is made, the event can only occur during the next five months.

$$P_f = \frac{5}{12} P_{NMP} = 2.0(10^{-6})$$

In summary, we conclude that the probability for failure of a line of sufficient size to cause potential for a catwalk missile over the next 5 months would be 2 x 10^{-6}.