ATTACHMENT 2

Design Analysis

Ginna Station

Main Steam and Feedwater Line Integrity Check

Rochester Gas and Electric Corporation

89 East Avenue

Rochester, New York 14649

EWR # 2846B

Revision 0

May 3, 1988

MBF 8/9/89

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Revision Status Sheet

Page	Latest Rev.	Page	Latest Rev.	Page	Latest Rev.
i	0				
ii	0				
1	0				
2	0				
3	0				
4	0				
5	0				
5a	0				

1.0 OBECTIVE: DETERMINE THE EFFECT OF FALLING MASONRY ON THE MAIN STEAM AND FEEDWATER LINES LOCATED IN THE INTERMEDIATE BUILDING. MAIN STEAM LINES UP TO AND INCLUDING THE STOP VALVES, FEEDWATER LINES UP TO AND INCLUDING CHECK VALVES. (30"ϕ M.S. LINE, 14"ϕ F.W. LINE)

2.0 DESIGN INPUTS

2.1 DESIGN CRITERIA, EWR #2846B, REV. 0, 2/2/87

2.2 SAFETY ANALYSIS, EWR #2846B, REV. 0, 2/9/87

3.0 REFERENCED DOCUMENTS

3.1 "TORNADO LOAD ANALYSIS FOR THE MAIN STEAM LINE AND MAIN FEEDWATER LINE, GINNA NUCLEAR POWER STATION, STEVENSON & ASSOCIATES, FEBRUARY 15, 1984

3.2 LETTER 13NI-RR-L1545, M. FITESIMMONS TO C. RIOCH, 4/30/87

4.0 ASSUMPTIONS 1) FALLING MASONRY WILL ACCELERATE DOWNWARD UNDER NORMAL GRAVITY, NO ADDITIONAL ACCELERATIONS FROM EARTHQUAKES ARE CONSIDERED.

5.0 COMPUTER CODES

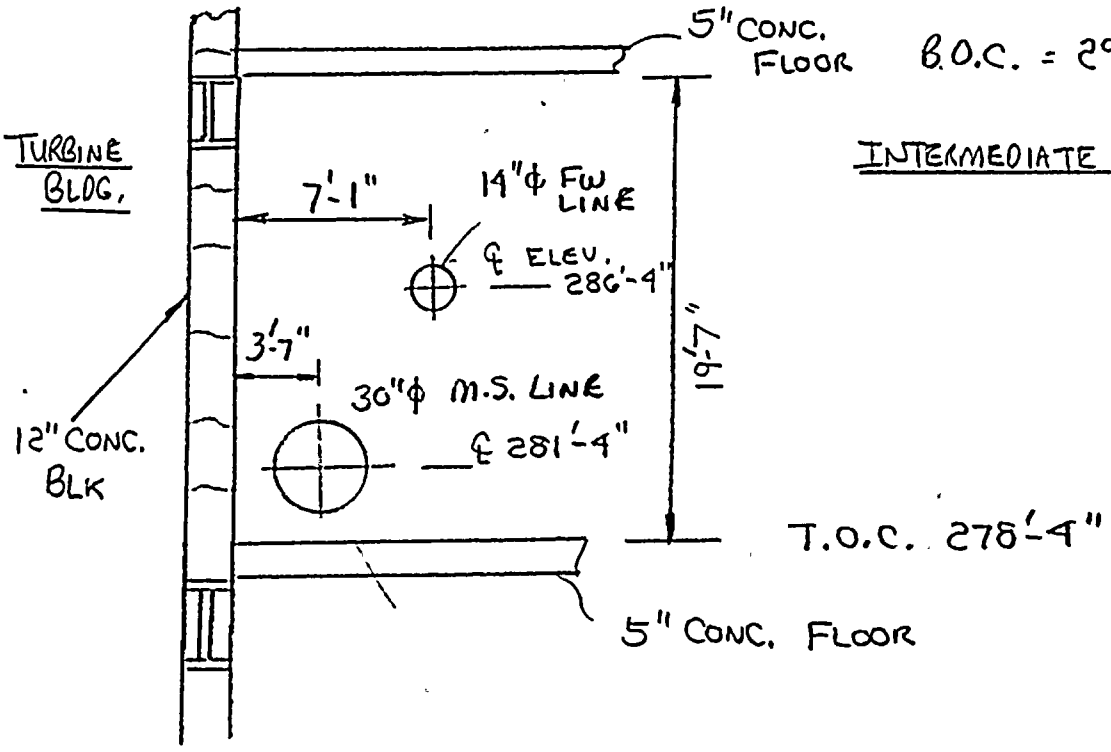
NONE

6.0 ANALYSIS - SEE BODY

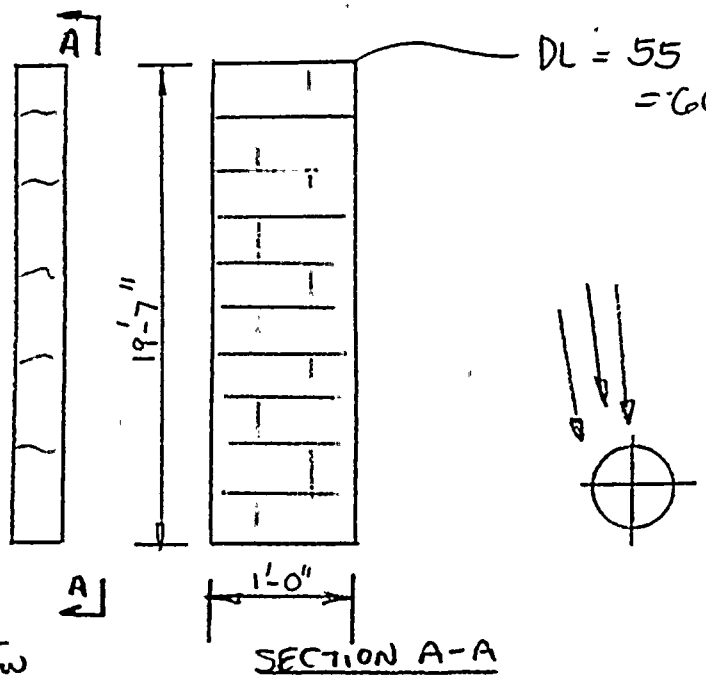
7.0 RESULTS - SEE CONCLUSIONS AT END OF BODY

APPROACH: THE REPORT REFERENCED IN SECTION 3.1 HAS CONCLUDED THAT THE MAIN STEAM AND FEEDWATER LINES ARE CAPABLE OF RESISTING DIRECT TORNADO WINDS, TELEPHONE MISSILES AND STEEL ROD MISSILES. THIS ANALYSIS WILL COMPARE THE ENERGY OF FALLING MASONRY WITH THAT OF TORNADO MISSILES WITH THE INTENT OF BOUNDING FALLING MASONRY ANALYSES WITH THIS PREVIOUS TORNADO ANALYES.

FALLING MASONRY ENERGY



ELEVATION LOOKING EAST



DL = 55 PSF BLOCK 5 PSF ATTACH.
= 60 PSF

REFERENCE 3.1
PAGE 1, 2 & 3 OF 47

$$\text{MASS} = \frac{19.58' \times (1.0')(60\ \text{PSF})}{g} = \frac{1{,}175\ \#}{1g}$$

CALCLATE EFFECT OF MASONRY ON STM LINE

$$\text{ENERGY} = \tfrac{1}{2} m v^2$$

CALCULATE VELOCITY OF TOP BLOCK WHEN IT HITS STEAM LINE.

$$\text{DISTANCE} = \tfrac{1}{2} a t^2 = d$$

$d = 20'$
$a = 32.2\ \text{FT/S}^2$
$t = ?$

$$t = \sqrt{\frac{d2}{a}} = \sqrt{\frac{20(2)}{32.2}}$$

$$t = 1.11\ \text{SEC.}$$

$$\text{VELOCITY} = at = 32.2\ \text{FT/S}^2\ (1.11\ \text{SEC}) = 35.89\ \text{FT/S}$$

$$35.89\ \text{FT/S}\ \left(\frac{1\ \text{m/s}}{3.281\ \text{FT/S}}\right) = 10.9\ \text{m/s}$$

CHECK TOTAL MASS OF 1-0" WIDE STRIP OF BLOCK LANDING ON STEAM PIPE.

WT BLK = 1175 #

WT IN NEWTONS = $1175^{\#} \left(\frac{4.4482\,N}{1\,LB}\right) = 5227\,N$

$M = W/g = \frac{5227\,N}{9.81\,m/s^2} = 533\,kG.$

$KE = \frac{1}{2} m v^2$

$= \frac{1}{2} (533\,kG)(10.9\,m/s)^2$

$= \underline{31,650\ JOULES}$ /FT OF LENGTH

THE ENERGY OF THE BLOCK FALLING DOWN OF 31,650 JOULES IS CONSIDERABLY LESS THAN THAT OF A TELEPHONE POLE MISSILE 2,760,807 JOULES. IT IS ALSO LESS THAN THE FRACTURE ENERGY OF THE PIPING FOR A STEEL ROD IMPACT, 66,414 JOULES.

SAFETY FACTOR $= \frac{E_F}{E_K} = \frac{66,414}{31,650} = 2.10$

THIS IS ACTUALLY MORE CONSERVATIVE BECAUSE IN THE ANALYSIS ALL THE MASONRY FELL 20'.

FEEDWATER LINE ANALYSIS

THE ENERGYS OF FRACTURE E_f FOR 14" ϕ FEED WATER LINE ARE:

REF. 3.1 PG. 28

FOR 12"ϕ UTILITY POLE 1,791,785 JOULES
FOR 1" ϕ STEEL ROD 73,104. JOULES

CONCLUSIONS DUE TO THE FEEDWATER LINE ELEVATION THE FALLING MASONRY CAN NOT SIGNIFICANTLY IMPACT THE LINE. A FULL WALL HEIGHT OF MASONRY HITTING THE FW LINE IS LESS THAN E_f. 31,650 < 73,104 JOULES.

SEE PAGE 5a FOR A MORE REALISTIC ANALYSIS OF MASONRY HITTING THE F.W. LINE. MBF 8/9/89

FINAL CONCLUSIONS:

THERE IS ACTUALLY 11'-7" OF 12" BLOCK MASONRY ABOVE THE ℄ OF THE 14"ϕ F.W. LINE THE LINE IS 7'-1" FROM THE SURFACE OF THE WALL. IF THE MASONRY WERE TO FALL SOME BLOCKS MIGHT REACH THE FW LINE AND INDUCE LATERAL IMPACT LOADS BEFORE FALLING TO THE FLOOR BELOW, BUT IT DOES NOT SEEM PRACTICAL FOR ANY MASONRY TO REMAIN ON TOP OF THE PIPE DUE TO ITS SIZE AND LOCATION.

FOR THE MAIN STEAM LINE THERE IS 15'-4" OF 12" BLK ABOVE THE TOP OF THE PIPE. THIS EQUATES TO 920 #/FT. DUE TO BLK SIZES AND PIPE LOCATION WHEN MASONRY UNITS HIT THE PIPE THEY WILL ROLL OFF ONE SIDE OR ANOTHER. THE RESULT WILL BE ONLY A MINOR BUILD UP OF RUBBLE ON THE PIPE.

FROM PAGE 2 OF 5 THE FEEDWATER LINE IS AT ELEVATION 286'-4". RECALCULATE THE MASS ENERGY OF BLOCK ABOVE THIS LINE WHICH COULD FALL AND IMPACT IT.

$d = (297'-11") - (286'-4") = 11'-7" = 11.58'$

$t = \sqrt{\frac{d(2)}{a}} = \sqrt{\frac{(11.58')(2)}{32.2\ FT/S^2}} = .848\ S$

$VELOCITY = a\,t = 32.2\ FT/S^2\ (.848\ S)$

$= 27.3\ F/S\ \left(\frac{1\ m/s}{3.281\ FT/S}\right)$

$= 8.32\ m/s$

$WT. = (11.58')(60PSF) = 695\#$

$WT\ IN\ NEWTONS = 695\#\left(\frac{4.4482\ N}{1LB.}\right) = 3090.6N$

$MASS = \frac{WT}{g} = \frac{3090.6N}{9.81\ m/s^2} = 315kG.$

$KE = \frac{1}{2}mV = \frac{1}{2}(315kG)(8.32\ m/s)^2$

$= 10,904\ JOULES/FT\ OF\ LENGTH$

THIS IS SUBSTANCIAL LESS THAN A PENETRATING 1"Φ STEEL ROD AND THE MASONRY BLOCKS HAVE NO PENETRATING CAPACITY.

$F.S._{MIN.} = \frac{43,104\ JOULES}{10,904\ JOULES} = 3.95$

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DESIGN ANALYSIS

EWR NO. 3990

PAGE 5A of 5

REV. 0

DATE 8/9/89